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AN INQUIRY

INTO THE

NATURE AND CAUSE OF MIASMATA.

AN

INQUIRY

INTO

THE NATURE AND CAUSE

OF

MIASMATA,

MORE PARTICULARLY ILLUSTRATED IN THE

FORMER AND PRESENT STATE OF THE CAMPAGNA DI ROMA.

By P. MURPHY, Esq.

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FOR

J. MURRAY, ALBEMARLE-STREET.

MDCCCXXV.

DEDICATION.

TO THE

MOST NOBLE THE MARQUESS OF HASTINGS,

&c. &c. &c.

My Lord Marquess,

Your Lordship's early initiation into public life, and the conspicuous place you hold among the distinguished personages of our times, have so familiarized society with the leading traits of your Lordship's character, as to render any particular allusion to them in this place superfluous.

I deem it, therefore, part of my good fortune, that in expressing my respect and admiration of those qualities and virtues so often and so eminently displayed by your Lord-

ship, whether in the *field*, the cabinet, or the more endearing walks of domestic intercourse, I but echo the general voice.

To whom, then, my Lord, could a work such as the present, having for its objects the advancement of science, and lessening the sum of human calamity, be with more propriety addressed, than to one whose bosom is known to be the sanctuary of benevolence—with whom the accident of *birth* is but of secondary consideration in estimating the man; who, the pride of the country that has the honour of having given him birth, and the favourite alike of the prince and the people, furnishes a rare instance that the exercise of the highest functions in a state, when discharged with honour and ability, instead of detracting from popularity, serve only to enlarge its sphere, and to shed on exalted rank its brightest lustre.

As to the merits or demerits of this little work, an impartial public will finally decide. With that public, however, the circumstance of being connected with your Lordship's name can hardly, in the first instance, fail to give it currency: its faults, whatever they may be, belong exclusively to its author; but should it be approved, and answer, in any way, its objects, your Lordship is fairly entitled to any merit it may possess, as, without your patronage, it is probable it never would have met the public eye.

I cannot conclude, my Lord, without expressing the deep sense I entertain of your Lordship's politeness to me; and wishing your Lordship a long enjoyment of those honours, which a life dedicated to the service of your country has accumulated on your name,

I have the honour to be,

My Lord Marquess,

Your Lordship's most obliged,

And most grateful, humble servant,

P. MURPHY.

PREFACE.

When I first conceived the idea of the present work, I was not ignorant of the difficulties I had to contend with; and the nearer I examined the subjects connected with my principal object, *the explication of the phenomenon of miasmata*, the more insurmountable these difficulties appeared, as I found it impossible on the theories hitherto established; this circumstance obliged me to seek for such explication on original principles.

Aware of the concatenation that exists throughout the extended scale of the phenomena of nature, I knew that in treating of a

particular class of those of the atmosphere, unless the principles on which I accounted for them equally applied to the explication of *the rest* of these phenomena, they could not be correct; and, consequently, that any thing I might offer on the subject of miasmata, in the absence of such determinate principles, could only extend to conjectures, vague and inconclusive.

Thus I found myself obliged, in order to attain my object with respect to accounting for the nature and origin of miasmata, to combine with the consideration of them, an inquiry into those of the other phenomena of the atmosphere, founded on the same principles on which I proposed the particular explication of miasmata. This has led to the dissertation on these phenomena which forms the *first part* of this work; and as the correctness of these principles is that only on which its success must depend, while a discovery of them has, since the dawn of

science, been considered an object of primary importance, I hope, in thus submitting them to the public, that none of the little passions which originate in the imperfection of our nature, will be allowed to interfere in judging of them; but as TRUTH, from whatever quarter it may come, is entitled to respect, they may at least have the benefit of candour in deciding on their merits, which is the utmost their author solicits in their behalf. I will add that I have not adopted them without a long, and, I hope, impartial examination; and that, in my opinion, *a strong presumption of their truth is to be found in their simplicity.*

In treating of the phenomena of the atmosphere on those principles, *some new phrases* became necessary; *these* I have made *as few* and *as appropriate* as possible.

I hope I may say, without vanity, that in the *third part* will be found some important views of agricultural science, which have

been the result of no inconsiderable practical experience and observation in rural affairs.

As my object, in treating of the principal subjects touched on in this inquiry, has been to trace them to the principles in which they originate, that thereby future industry might have the advantage of certain *data*, as regarded them; and as *principles*, though difficult to be established, seldom require much space for explanation, when found, I hope my work, unlike those of the poet mentioned by *Smollet*, will not be judged of so much *by its bulk*, as by the other claims it may possess to public attention.

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INTRODUCTORY OBSERVATIONS.

IN tracing the history of the human mind in its progress towards knowledge, it will, probably, be found that the most fertile of the various sources of error which have, at all times, impeded its advance, has been an ignorance of *first principles*, or fundamental truths. These being founded in nature, constitute, as it were, the germens from which science, of whatever kind, must first derive its vitality, and afterwards, by a judicious application, its gradual development and mature perfection. But, where they are not truly understood, the only clue to successful inquiry is broken; and the mind being in a manner benighted, doubt and uncertainty involve its course, and, hurrying forward with energy from false premises, it finds itself involved in labyrinths, in which the further it advances the more it is confused, and

from which, at length, it finds it difficult to recede, and impossible to deduce any thing with certainty.

It, therefore, becomes a matter of primary importance, in considering *effects*, to understand their *causes*, in order to be able to influence the former, as circumstances may require.

With this view, it will not be foreign to the present Inquiry to examine how far heretofore received opinions, as to the manner in which *light* and *heat* are communicated by the sun to our earth, are well founded; it being chiefly by the agency of these that the grand machinery of nature, in the animal and vegetable kingdom, is kept in movement.

According to those opinions, the sun was supposed to be a body of fire, from which, placed in the centre of its system, emanated the attributes of light and heat to the dependant orbs that revolve around it, in quantities proportioned to their relative distances; the nearest being supposed to experience a height of temperature many degrees warmer than red-hot iron, while those most remote were supposed to be exposed to an intensity of cold, many degrees below Zero.

These conclusions naturally resulted from making our earth the standard, by which the temperatures of the other planetary bodies were to be measured. But, in considering the works of the Creator, it should be borne in mind that he is not

only the source of *life* and *being*, but of *wisdom* and of *beneficence;* and, consequently, that the nearer we can approach his designs in projecting creation, on chaos, the nearer we shall find ourselves to truth.

Thus, bound as we are to suppose that creation was the effect of a Providence, all omnipotent and good, in which nothing was done in vain, and, consequently, that each of the planets that compose our system was, like that we inhabit, designed by God to be a theatre of life and of intelligence, it follows that we must believe the other globes of the solar system *uninhabitable* from the excess of heat or cold to which they are exposed, or inhabited but by beings differently organized from any we are acquainted with; one or other being the consequence, if light and heat be communicated by the sun, according to these opinions. But, in order to demonstrate this, it were necessary not only that the heat of the sun was sufficient to extend to the extremities of the solar system, but that the *atmospheres* of the different planetary bodies, of which it is composed, should extend respectively from them to the sun's disk, without which the heat of the latter, wanting a *conductor*, would be confined to itself, and as far as regarded those planetary bodies, become neutral.

The contrary of this, however, is admitted to be the case; our atmosphere, according to the

most accurate calculations, taken from its* power of refracting the sun's rays above the horizon, being 44 to 45 miles only in height, or about the 175th part of the earth's diameter; all beyond being considered a species of vacuum, or ether, so rare, as to be incapable of transmitting *heat*, or even *light*, in a requisite quantity. Thus it becomes necessary to seek other explanations for these phenomena in the atmosphere than that alluded to.

Let it, then, be supposed (as I wish only to put it hypothetically) that the atmospheres that encompass the different planetary bodies composing the solar system are intended by the Creator, not only as the theatres of various phenomena, but as *vestments*, by which the animal and vegetable bodies they sustain were to be protected from the excesses of each extreme of temperature, and adapted in their elevations and densities to their relative distances from the sun.

Let it also be supposed that the sun's body (the diameter of which is computed to be 111 times that of the earth) is specifically equal to the collective amount of the planets that encircle him; that he is likewise furnished with an atmosphere, but different from those attached to the former, being, from its extreme subtilty, nearly immaterial, with the property of diverging in right lines from his body, and extending

* This, as will be shewn hereafter, is not a correct principle by which to measure the height of the atmosphere.

to the extreme superficies of his system, filling the entire regions of space within its extended circumference; but incapable *of itself* to produce either *heat* or *light*, when not opposed by those of the planets; and that its power of producing both in those is (as we find it) in an exact ratio to the angles of opposition they form with each other, constantly diminishing in their effects of producing these phenomena as they recede from a vertical opposition, and increasing in their power of producing both, as they approximate to it.

This hypothesis derives additional weight from the circumstance, that as far as it regards the earth, it differs little from that of the immortal Newton, as he observed the necessity that existed of an opposition to the *sun's rays*, in order to their producing the phenomenon of *heat;* but, instead of being the effect of a permanent atmosphere attached to the sun, he conceived these rays to be particles of inconceivable minuteness, emitted or flowing in a perpetual stream from the sun's body, into the regions of space, in which they were eventually lost. But, by changing this latter position, and for the *sun's rays* substituting *the sun's atmosphere;* and, supposing that such an organization and dependance exist between the sun and the different planets of his system, in the distribution of *light* and *heat*, as are observable in the revolutions they perform in their respective orbits, effected by means of the atmospheres of the latter

being adapted to their relative distances from the former, *viz.*, that these nearest are furnished with atmospheres proportionally rare and circumscribed in elevation to their proximity: while those more distant are furnished with atmospheres of a density and elevation proportioned to their remoteness, in such a manner as to produce, by means of such difference in their volume and elevations, a common standard of light and heat throughout those widely-dispersed bodies.

By viewing the works of creation in this way, all incongruity vanishes. We no longer contemplate a portion of the planetary bodies inhabited by *salamanders,* and others consigned to *torpedoes;* but all appears harmonious and conformable to the idea we should entertain of the works of an all-wise and beneficent Providence.

A further proof of the correctness of this theory, as regards the distribution of *light*, and its consequent attribute heat, throughout the planets, by means of their atmospheres, were it necessary, is fortunately furnished by these bodies themselves, as they appear from the earth; for as it is more than probable that *earth* and *water* are distributed over their surfaces in a manner equally diversified and irregular as that in which we behold them on our globe; and that, of these elements, *water only* is capable of reflecting light; those bodies, consequently, if seen at all, would appear of any form rather than that which they assume; but

their atmospheres partaking of their external form, and being illuminated, give to us, as seen *from without them*, the conformation of bodies equally spherical as the sun itself.

The *moon*, however, by reason of its proximity, is that which more particularly marks, in distinct lines, the illuminated portions of its atmosphere, as it approaches towards, or recedes from, the sun, in its periodical revolutions round the earth; constantly exhibiting, in its changes, the perfect rotundity, or minor portions of a sphere, which, from the reason assigned, could not be the case were it the body of the planet from which we derived the reflection that apprizes us of its existence.

The uniformly luminous appearance of the planets is owing to the circumstance of their being seen by us *from without their atmospheres*, which being always equally lucid in the superior regions that form their exterior, are, necessarily, what come in contact with our vision, while the inhabitants of the planets, circumstanced, with regard to those atmospheres, as the inhabitants of the earth are with respect to theirs, *viz.*, seeing them from *beneath*, may experience all the vicissitudes of *fair* and *foul* weather, of shade and sunshine, to which we are subject.

It is worthy remark that the planets appear to increase in magnitude as they recede from the sun; these nearest bearing no proportion, in this

respect, to those most distant. But as the reflection we have of them is not from the globes themselves, but from their illuminated atmospheres; and as *these* may increase, as already mentioned, in their volume and elevation, in a ratio proportioned to their distances from the sun; and as the calculations that have been made of their magnitudes would, consequently, be founded on false principles, it may afford room to suspect that these calculations are not strictly correct.

I cannot conclude these observations without remarking that a theory such as the above is necessary to explain the long entertained and favourite opinion, *viz.*, that the *stars* are so many *suns*, with each its planetary bodies revolving round it. For by supposing that the lucid atmospheres of these celestial bodies extend no further in the regions of space than the extent occupied by their dependant planets, each of these stars, seen from within its own system, might, by the magnifying effects of its atmosphere, and those attached to its planets, appear equally large as our sun; while viewed *from without its lucid atmosphere*, from the planets of other systems, and, consequently, deprived of the magnifying effect of these, they would diminish in appearance to the size of ordinary stars. Thus the light produced by each would be adequate to its own system, at the same time that it interfered not with that of any other; and thus multiplied systems, as innumerable as are these celestial bodies,

and unlimited as space, might extend the scale of being beyond the limits of the human understanding to conceive, and worthy the majesty of a DEITY, infinite in wisdom as in the rest of his divine attributes!

ON THE ATMOSPHERE AND ITS PRINCIPAL PHENOMENA.

A CORRECT theory of the atmosphere, however desirable to science, or advantageous to society, may still be considered, from the difficulties which have always opposed themselves to it, as little more than in its infancy.

These difficulties may be divided into two classes, *viz.*, those arising from the inadequacy of the *senses* to ascertain or even discriminate between the properties of the heterogeneous mass of gaseous substances of which it is composed; and which being generally insipid and colourless in their simple as well as combined state, elude alike their perceptions, thus depriving them (the senses) of all but the imperfect capacity of ascertaining temperature, and discriminating between pleasing and disagreeable odours, tastes, and colours; without the power to ascertain, but by experience, their various effects.

The other class consists in the ignorance of the *agency* by means of which this gaseous matter composing the atmosphere is supplied, and afterwards made to recombine and adapt itself in an infinity of modifications to the purposes of sustaining *vegetation* and *life*; as *both these* may be said to

derive their vitality from it; it being not only the theatre of a variety of phenomena, but the reservoir from which the elements of sustenance, as well as of dissolution, *in these* kingdoms are drawn. And were it not for some lights elicited by modern discoveries, together with certain *data* furnished by nature, it is probable these obstacles would continue to oppose such a bar to research as would render future inquiry equally unavailing as that already made to develop the principles that have so long involved these phenomena in mystery. And perhaps to the above obstacles a no less formidable one will be found to have its source in a quarter that would least be suspected of it; *viz.*, that of making analysis and experiment the sole means by which to guide physical inquiry; as those at best are only calculated for arriving at the knowledge of the component parts and peculiar properties of particular substances. In this I wish not to be understood as undervaluing the importance of this species of inquiry, as it is by means of it that chemistry has been made so available to the arts. Yet as to its being the means most likely to lead to a knowledge of the laws from which the "harmony of things" observable in the works of creation flow, or the various phenomena resulting from their movements, it were the same as to expect, by the discovery of a particular spring, wheel, or pivot, belonging to a complicated piece of machinery, that the mind

would arrive at the knowledge of its construction and of the principle on which its mechanism was founded; or that it were possible to compress within the narrow round of a chemist's apartment the grand laboratory of nature, where alone her divine affinities, and the results emanating from them, can be traced through the intricate maze of her endless combinations.

Therefore to him who would indulge in the laudable ambition of studying the CREATOR in this grand department of his works, with the double object of increasing his homage for the one, by arriving at a more perfect knowledge of the other, and of converting such knowledge, thus drawn from its source, to the advantage of society, it were necessary that he should have, not only a perfect conception of what science has already effected towards the explication of these phenomena, but an attentive and patient observation in different climates and situations of the manner in which they manifest themselves.

Before I enter on the main subject of inquiry, I shall therefore take a compendious view of what are called *original elements*, or those substances from which philosophers suppose all terrestrial bodies to be formed; as a right conception of them may prove not a little efficacious in aiding us to form just conclusions.

These, according to the Aristotelian philosophy are *four* in number; *viz.*, earth, *fire*, air, and

water. Modern research has exploded this hypothesis, without, however, substituting a better in its stead. This hypothesis has resulted from the discovery that these substances that were formerly called elements, are subdivisible into fifty-two *ponderable* and four *imponderable* substances; and these latter are indebted for the term "primary substances" solely to the circumstance that science has not been able *as yet* to decompose or subdivide any of them, which should it be able at any future time to accomplish, this number may possibly be increased tenfold.

And were the case other than it is now found to be, with what were conceived to be *the original elements*, viz., that they were composed of a number of elastic decomposable substances, held in various states of combination by particular laws, and in this state assuming these determinate forms called *elements*, how were it possible that the elastic part of these elementary bodies could be made susceptible *of changing into each other?* on which principle of *circulation* their regeneration appears to be founded.

On this subject I think it right to give the following sensible passage from the introduction to Dr. Ure's valuable Dictionary of Chemistry. "It is possible that the elements of *nature* are very dissimilar, it is probable that they are altogether unknown, and that they are so recondite as for ever to elude the sagacity of human research."

Without stopping to determine the validity of the opinion here expressed, whether " these elements of nature shall for ever elude the sagacity of human research," or not, (as the substances into which they are supposed finally to resolve themselves are those denominated *elements* by the ancient school,) by limiting them to the original number, it will have the effect of simplifying the consideration of nature and her phenomena, inasmuch as from an indefinite and confused idea, it presents their basis in a determinate shape to the mind.

I shall therefore inquire how far the ancients were justified in applying the term *element* to these substances. By the term *element* is understood a substance *permanent in its existence* and *general in its application;* as a deficiency in either quality would disqualify these elements from being what the term presupposes, viz., *universal agents*, and judging them by this standard, we shall find that but *three* of these substances answer to such definition: *fire*, as we understand the term, never having been intended to be other than *local* and *temporary ;*—but if by the term *fire* was meant *caloric*, or the matter of heat, then it would not only answer to what is understood by the word *element*, but is the only one of these that can be regarded as simple or indecomposable, and whose importance in nature is such, that it may be regarded as the main-spring or vital principle by whose agency the other elements

are kept in movement, and which, though heretofore regarded as *imponderable*, I hope to prove possesses that quality in an eminent degree; constituting as it does the base of *water* and of *atmospheric air*. I shall therefore, in treating of *caloric*, notwithstanding its infinite subtility, consider it as a material and ponderable substance, the same as air, water, or earth; as co-existent with them in origin, and forming an integral part with them in the works of creation.

Having premised so far on the elements of nature generally, and on *caloric* in particular, I shall resume the subject of inquiry.

The immense body of aëriform and elastic matter encompassing the earth on all sides, called the atmosphere, is composed of an infinite number of gaseous substances, not less opposite in their specific densities than in their particular qualities, and the affinities they bear to each other. This body of matter placed between two opposite principles is, by their reciprocal action on it, never permitted to be stationary in its density or temperature, but influenced by one or the other is kept in a continual state of oscillation and change, insomuch that were it not that under particular circumstances it uniformly manifests *the same appearance*, it is probable that, from its *intangible* nature, and the impossibility of submitting to analysis the air of the superior regions, and thereby ascertaining the difference that exists between it

and that of the lower, it must have always continued to elude human inquiry as to the principles by which its phenomena are governed.

The circumstances here alluded to are those observable *while the atmosphere is in the extremes of its temperature;* when exposed to which its horizontal currents are suspended, and its entire volume clear and translucent; which circumstances appear to furnish the most certain *data* to guide research, in tracing to their causes its various phenomena.

Again, as the density and temperature of the atmosphere are constantly found to be proportioned to the *inverse ratio* of its elevation, and of he distances of places from the equator, gradually lessening in both as we ascend the one, or advance from the other, it follows, that at a certain elevation, even under the *line*, water looses its fluidity; and that at distances remote from the equator, this effect is produced much nearer to the earth's surface, and is called *the point of congelation;* and when, as at the equinoxes, the sun is equidistant from the poles of the earth, this point coming in contact with its surface at either, and thence gradually attaining a greater elevation as it approaches the tropic, describes an extensive arch* in the atmosphere, called *the curve of congelation*, resting its extremes on either Pole, and (as stated above) attaining a greater elevation

* I was originally indebted for this idea to an article I saw in one of the Edinburgh Reviews some years ago.

as it approaches the equator, where it is most distant from the earth's surface.

Hence it follows, that the atmosphere is naturally divided into different climates or regions in its elevation, just as in its extent along the earth's surface: that part next the earth may be called the warm or torrid; and that immediately above this region the temperate, surmounted by the cold or frigid. And during the *extremes of temperature*, or whenever the air is perfectly still and cloudless, the atmosphere may be said to be harmonious in its parts, or to have its different regions fairly adjusted to each other, both in *gravity* and *temperature* along the gradually diminishing scale of both, from its base to its extreme superficies. Consequently, as these extremes of temperature in it are mutually found to produce similar effects as to serenity and clearness, and neither can of itself change or interrupt this harmony of its parts, it will follow (as I hope to prove) that it is to *the approximation and blending of these opposite temperatures* much of the phenomena observable in it owe their origin.

The elevation and range of caloric in the atmosphere are, properly speaking those of this body itself, as it may be denominated the *charpente*, by means of which the heterogeneous mass of gaseous matter composing it is sustained; the more dense and ponderous part of this necessarily occupying its lower region, and requiring proportionally more

caloric to hold it suspended in a gaseous state than that of the regions above it, as it exceeds that in specific ponderosity, and the amount of adhesive force by which its particles attract each other; the lighter and more inflammable, as requiring least for its buoyancy, necessarily occupying the higher regions.

Thus the curve of congelation in the atmosphere, instead of being the extreme point to which caloric ascends, may perhaps with more justice be considered but as a centre link in the scale of its temperatures; as without some portion of it the particles composing the lighter of these gaseous bodies would necessarily coalesce into a coherent aggregate.

That the phenomena in nature to which the term *electricity* owes its origin, are of such magnitude as to justify the supposition that they were effects produced by a peculiar *fluid* or element to which this term was affixed, is not to be wondered at, seeing that according to existing theories no better explanation of such phenomena could be given; but that such an element really exists appears to rest on very questionable grounds; as what are called *electric phenomena* might perhaps with more justice be ascribed to *combustion,* of which they appear to be no more than a particular species.

There appear to be *two perfect*, as likewise *two imperfect*, species of calorific condensation in the

atmosphere, and equally opposite in the regions in which they occur, as in their results. The former of these, as being the principal, I shall proceed to comment on. One of these produces *drought* and *heat*, the other *humidity* and *cold:* the former in conjunction with the agency of the sun's rays, decomposing the waters and other perishable substances of our globe in proportion as they putrefy, or become unfit for the purposes for which they were intended, and disseminating their component elements throughout the atmosphere, renovate its parts; the other *recomposing* the vital element of water, return it in nearly equal measures of distribution in a purified state, to the different regions of the earth. The first is that occasioned by the action of the sun's atmosphere on our's at the surface of the earth, in disengaging and concentrating caloric there; which commencing in the spring, continues gradually to augment as the cause producing it acquires power. The other is that which takes place *about the curve of congelation, when opposite temperatures are brought into contact.* This latter being one of the fundamental principles on which I have ventured to found the present theory of the atmosphere, it becomes a matter of the utmost importance to establish the fact on grounds the most unquestionable; as without adducing proofs amounting to demonstrative, I could hardly anticipate the

attention, much less the sanction of the scientific world in its support.

In a former paragraph it is mentioned, that during the extremes of temperature, the atmosphere is perfectly *still, clear*, and *harmonious* in its parts; consequently, that neither extreme can of itself interrupt this harmony; and finally, that it is to the approximating and blending of these opposite temperatures many of its phenomena owe their origin.

Assuming, then, that the atmosphere owes its purification and salubrity to the principle of *circulation* or the uninterrupted renovation of its parts, in proportion as the gaseous matter, of which it is composed, assumes a fixed or solid state in the various substances into the formation of which it enters, and of which *water* is the chief; I proceed to the *proofs* I shall adduce in support of the position, that this operation, *i. e.*, the formation of water in the atmosphere, is effected by the approximation and blending of its opposite temperatures;—affording an additional illustration of the simplicity of the means used by nature to effect objects the most important in her general economy.

When the temperature of the atmosphere causes the mercury of a barometer to fall to the *freezing point*, it will be observed, that, in an apartment moderately warm, a deposite will instantly begin

to form on the interior of the glass panes in the windows; and that this, from a *little*, gradually increases, until at length it descends in large drops of *pure water* along the surface of the panes; or being congealed, covers them with a sheet of ice. This phenomenon can only proceed from the caloric with which the air of such apartment is impregnated, in conjunction with a portion of the air itself, coming in contact with an opposite temperature; when a condensation of their volume takes place on the plane of their contact, and the formation of water is the result. Again, when in warm climates, *iced water*, wine, or other liquid artificially cooled, is put into a decanter or other glass vessel, the caloric of the atmosphere coming in contact with the exterior of such vessel, a similar condensation takes place covering it with *a palpable dew**.

For further proof of the correctness of this theory, I shall have recourse to nature's grand laboratory, the atmosphere itself. In this, we shall find that *cold* is equally efficacious as *heat*, in dissipating the elements of which water is composed,

* In the first volume of the *Oriental Field Sports*, London, 1808, by Captain Thomas Wilkinson, p. 305, is the following passage, in describing the artificial means resorted to for cooling wine, water, &c., in the sultry regions of the east. "A very slight degree of cold in so very warm an atmosphere causes the air immediately in contact with the glasses (containing such liquor) *to form large globules on their exterior, which stand like a heavy dew thereon.*"

in the incipient, or first stage of its condensation. In the early part of night, at the commencement of a *frost,* when the atmosphere is usually overcast with clouds, they will be observed to disappear one by one, like snow-flakes exposed to the sun, till the blue concave of the heavens becomes wrapped in a sheet of transparent ether, exhibiting its celestial splendours along the unbroken extent of its mighty expanse. This could not happen were it not that *caloric* forms the bond of their connexion; and being absorbed from them by the increasing cold, causes the elements combined with it (caloric) to resume their original colourless and simple state.

In a more advanced state of their condensation, however, the result of increasing cold is different; for in this stage, caloric having acquired *a fixed state* in the mass of forming vapour, the condensation resists the action of cold, and descends in snow; this latter substance, requiring an addition of *caloric* to change it into water. And as it is a well-ascertained fact, that snow possesses some peculiar properties distinct from water, the latter cannot be considered as perfect while in that state. The tumefactions in the throat, *&c.*, so common with women and children in Switzerland and other mountainous districts, called the *Goitre,* (which, besides making the unhappy persons afflicted with it frightful objects of deformity, is said to make the children perfect idiots) are thought to be occa-

sioned by the use of the *snow-water* of which their rivers are composed, rushing down to their valleys in an imperfect state of solution.

On the other hand, it is not wonderful that the sun's agency, which is capable of dissolving the bond of connexion in this element when perfect, should have the same effect in dissipating it in the incipient stages of its formation.

Thus, on whatever side this important process of nature is viewed, it is apparent that caloric is not only an integrant part in the formation of water, but that it may be regarded as the bond or cement by which the other gaseous matters combined with it, in its formation, are held together.

Having discussed the principle on which the formation of water in the atmosphere appears to be effected, I next come to examine the *means* employed by nature to accomplish her intentions in this process, which will be found no less worthy our admiration, than the principle itself on which it is founded.

In a former paragraph it is said, that "when the atmosphere is clear and harmonious in its parts, it is not in the power of the extremes of temperature *of themselves*, by which such harmonious disposition is produced, to interrupt or change it:" and hence the necessity of *counter-agents* to break in on such uniformity, and by this means consummate the designs of nature.

The chief of these are to be found in the com-

bined effect of the diurnal and annual movement of the earth round the sun, and its own axis; which, by causing a continual change of position between these bodies, necessarily produces in the atmosphere a variety of currents. To this must be added, that of the moon in her monthly course round the earth; which, as it is known to affect the *tides*, may well be supposed to have a more powerful effect on the more elastic matter composing the atmosphere, particularly in its higher regions, where such influence is principally required.

But these of themselves are insufficient to the accomplishment of her designs, as their effects are to a certain extent permanent and general; whereas, the necessities in the established economy of the earth, which they were designed to meet, are frequently temporary and local.

Thus, were the form of our earth perfectly spherical, without inequality of any kind on its surface; and if the substances composing or appending to it possessed an equal power *of reflecting caloric*, the curve of congelation in the atmosphere about the time of the equinoxes, would describe an arch, regular in the spring of its extent from either pole, towards the equator, exactly conformable to the figure of the earth, and of the sun's relative action on it. And thus being only affected by the change of the seasons, the atmosphere would have but *two main currents;* viz., from

either pole towards the equator; and from the equator to the poles, as the sun in his approach to either solstice would influence it. The consequence of this uniformity would be, that during one half of the year, one hemisphere would be deluged with rain and snow, and exposed to an intolerable cold; while the opposite hemisphere, parched with uninterrupted drought and heat, would have its rivers dried up, and its vegetation destroyed; and thus depriving man and other animals of their accustomed nutriment, would be changed into an uninhabited and cheerless solitude; at the same time, that the other hemisphere was exposed to devastations equally destructive from an opposite cause; and would itself, in turn, experience all the desolating effects of drought and heat, insomuch, that with such a disposition of things, the earth, instead of being a nursery of vegetation and life, gradually extending the dominion of both as it has done, would be totally depopulated in a single year.

Hence, the necessity of *a secondary class of counter-agents,* to break the uniformity of the effects that would result from the former; and *these,* from being partial or confined in their effects to particular districts, I shall denominate *localities.*

These localities that exercise so important an influence on the phenomena of the atmosphere, are of *two kinds.* One consists of the mountainous elevations of the globe, the other of the oceans,

seas, lakes, *&c.*, where water exists in the aggregate. And it is worthy remark, that whereas the latter are nearly equal in their distribution over the regions of the earth, north and south of the equator; the former are found to increase in elevation from the plane of the latter, as they approximate to the equator; those of the Polar regions bearing no proportion, in this respect, to those under the line; thus, advancing towards the curve of congelation in the atmosphere, in proportion as this latter recedes from the plane of the horizon; and consequently, being everywhere adapted (according to the present theory) to one of the chief purposes for which they were designed.

In order the better to understand this supposed influence of mountains, it becomes necessary to inquire more particularly into the nature of the sun's agency in exciting *caloric* in the atmosphere. I shall therefore briefly state what occurs to me on this important subject.

The body of the atmosphere, as calculated from the elevation at which it *refracts light*, is said to be about 45 miles in height from the plane of the horizon: therefore, taking this to be its true elevation (which I hope to prove is not the case), the circumference of this body, at its surface, must be in proportion greater than at the surface of the earth. Now, it being the surface of the atmosphere that first receives the rays of the sun, and

its volume becoming more dense as it approaches to the earth, the consequence will be, that those rays striking on its surface will *converge as they descend;* and the extreme point of this convergence being the surface of the earth, their effect will, on the principle of the *lens*, or burning glass, be greatest at this point. Thus it is extremely probable that the first effect of this convergence of the sun's rays in the atmosphere is the phenomenon of *light;* and that their further convergence superadds to this, the phenomenon of *sensible heat,* or the calorific condensation of the atmosphere, at the surface of the earth. Consequently, if light be the effect of the incipient convergence of the sun's rays in descending the atmosphere, its true height may be from 90 to 100 miles*. The view here taken of the phenomena of light and heat is, that they are effects resulting from the form of the atmosphere, with respect to the transmission of the sun's rays; and the consequent varied scale of excitement on its caloric produced by such convergence, in the descent of the rays to the earth, together with the gradual condensation, and con-

* This opinion is supported by Dr. Halley's calculation of the height of the great meteor described by him, appearing to be 90 miles, and his conclusion hence, that as these luminous bodies cannot originate or exist beyond the atmosphere of the earth, the then existing theory of the height of the atmosphere (being that at which it is capable of refracting light) was incorrect.

sequent rebound of caloric from this plane of its projection into the atmosphere above it.

Thence it will follow, that as opposition to the sun's rays at different elevations from the plane of the horizon must cause inequalities nearly similar in the *curve of congelation* above them, it is evident that their coming in contact with the summits of lofty mountains must generate calorific condensations in the atmosphere above them, in a region dissimilar and detached from that in which this species of condensation may be said permanently to exist in the aggregate, as water does in the ocean. The effect of this will be the approximation of the calorific condensation with the opposite or frigid temperature, and the consequent phenomenon of the *formation of water;* and in this disposition we behold the secret by which nature furnishes, with a never-failing supply, the sources of the principal rivers of the globe.

Before entering on the consideration of the agency exercised by the other species of *localities* on the atmosphere, I shall explain what I conceive to be the manner of the origin, progress, and consequent phenomena of *its aqueous condensation,* on the principle I have supposed; selecting, as an instance, one of those tempests so common in warm climates.

Suppose, then, a calorific condensation transmitting a warm current of air from the side or top

of one of the lofty peaks of the *Andes* into the frigid region of the atmosphere that eternally invests their snow-capped summits, a diminution, or concentration of the volume of this current will take place, changing it into vapour. It thus assumes the appearance of a speck, or cloud, and the first stage of the *aqueous condensation* is effected. This *speck* forms the nucleus of the incipient tempest; and the condensation thus commenced, producing a species of vacuum, the surrounding atmosphere rushing into it, and thereby supplying the necessary pabulum, it increases rapidly in bulk, and, like a train attached to a mine, following its principal pabulum, *caloric*, it descends, the sky producing therein a species of rotary movement, or vortex, as it advances; imbibing hydrogen and other light gaseous matter from the superior, and oxygen and caloric from the inferior region of the atmosphere; where, if the supply of the latter be copious, the condensation proceeds with such rapidity, that *ignition* is produced, and the highly inflammable gaseous matter in an imperfect state of condensation, with which it is saturated, catching the spark, a sudden and violent explosion rends the mass, causing the phenomena of *thunder* and *lightning*.

The gaseous matter in process of condensation being thus on a sudden chemically changed, causes a vacuum to succeed throughout the cloud, the aqueous particles of which being thus freed from this intervening medium, and simultaneously

uniting by the compression of the surrounding atmosphere, perfect the condensation.

The aqueous condensation thus accelerated by *aërial combustion* is usually the source of what are called *hail-storms*, and appear to owe their origin to the circumstance of the condensation not exceeding the *second stage*, when the caloric and other gaseous matter, composing its pabulum, and changing from their *aëriform* state, have passed into that of a *coherent aggregate*, in this their new state of combination. At the moment when their particles are thus suddenly coalesced, assuming in their transition a regular determinate form, they cohere in globular congealed grains, which, from their specific gravity and form, are rapidly precipitated through the atmosphere, in a perfect state on the earth, where, quickly imbibing the requisite dose of caloric, they dissolve into water.

An important and most salutary effect of *aërial combustion*, or thunder, is that of terminating the rotary movements in the middle region of the atmosphere that usually precede it; as these movements, collecting within their ample vortices the heterogeneous elements of the opposite regions of the atmosphere, would continue and extend the aqueous condensation, as long as its principal pabulum, *caloric*, was supplied in an adequate quantity by the region next the earth; thereby deluging the districts in which they occurred, and destroying their vegetation, by lowering the tem-

perature of the air to nearly the freezing point. Now *aërial combustion*, which originates in *the sudden compression of volume** of the gaseous matter of the atmosphere thus entering into condensation, suspends their further action, by extending its explosive effects throughout their extent, therein perfecting the process of condensation, and bursting the nucleus round which they were collecting. Thus the atmosphere, having discharged the aqueous matter formed in it, shortly recovers its equilibrium.

When, as is the case about the time of the equinoxes, the opposite temperatures of the atmosphere are most generally blended, during their respective transits of ascendency, it is, (as is well known), that the aqueous condensation becomes most extended and copious, particularly the autumnal, from the redundance of caloric with which at that time the atmosphere is saturated. But when the temperature of its lower region exceeds not a certain degree of warmth, the aqueous

* According to experiments made by M. Gay-Lussac, a condensation of volume in atmospheric air, amounting to *four-fifths*, is sufficient to *ignite tinder*, and as it has been ascertained, that in a cubit inch of water there are 1325 cubit inches of hydrogen and 662 of oxygen gas; or that a condensation of nearly *two thousand volumes into one* takes place in its formation in the atmosphere; I, therefore, conceive myself justified in my inference, that it is owing to the rapid condensation of volume attendant on the formation of water, that the ignition and consequent combustion in thunder-clouds are to be ascribed.

condensation, from the want of supply in its chief pabulum, goes on so slowly, that it is perfected without thunder, or *aërial combustion* being the result, which, accordingly, is rarely heard of, either during *the winter months*, when aqueous condensation is most frequent, or in *polar latitudes*.

Before quitting the subject of the *aqueous condensation* of the atmosphere, I cannot help expressing my surprise, that in the early experiments of Dr. Priestley, Mr. Cavendish, Lavoisier, and M. de la Place, in which they discovered that hydrogen and oxygen were component parts of this element; or in the grand experiment conducted by Fourcroy, Vauquelin, and Seguin, in 1790, in which combustion was kept up 185 hours, and 25,963,568 cubic inches of hydrogen, and 12,570,942 of oxygen gas consumed to obtain about *twelve ounces of water*;—it never appears to have occurred to them that the matter of caloric, by means of which they conducted their experiments, entered into the compound, for had they been aware of this fact, a quantity ten times the amount, without expense or trouble, might have been obtained by them in part of a frosty night, in the manner described at the commencement of this article, and thereby a certain basis would be laid for future inquiry. It is likewise a little remarkable that the circumstance of the facility with which the formation of water in the atmosphere is effected, as compared with their elaborate and tedious process, did not

satisfy them that a material part of this phenomenon was still hidden from them. But then this part was assigned to the agency of *electricity*, which in modern chemistry appears to have played nearly the same *rôle* as *enchantment* was supposed to act in the days of chivalry described by Cervantes.

Having thus disposed of my inquiry into this part of the atmospheric phenomena, I shall proceed to a consideration of the effects produced on the atmosphere by the second class of *localities*, viz., oceans, seas, *&c.*, where water exists in the aggregate. These being so intimately connected with a particular class of the atmospheric phenomena, as that a consideration of the one necessasily involves that of the other, I shall, in treating of their influence, discuss the *principle* or cause of the winds.

THE WINDS, OR CURRENTS OF THE ATMOSPHERE.

It is remarked, in the preceding article, that the calorific condensation of the atmosphere, by which heat manifests itself in various degrees of temperature, is occasioned by the convergence and pressure of the sun's rays in their descent to the earth. Now the effect of this condensation (as the term implies) is a compression of its volume, which increasing in the inverse ratio of its elevation is necessarily greatest at the surface of the earth; the substances forming the opposing strata of which considerably accelerate or diminish its progress, extent, and degree: as the more susceptible these substances are of absorbing caloric, the less will be their power of reflecting it; and the less their power of absorption, the greater consequently will be that possessed by them of reflecting it into the atmosphere.

To this principle in the bodies composing or appending to the surface of the earth, *viz.*, the difference in their powers of reflecting caloric, it is owing that *water,* where it exists in the aggregate, from its inadequacy in this respect, as contrasted with *land,* exercises an influence on the phenomena of the atmosphere, thereby occasion-

ing along the line of their junction effects nearly similar to those produced by mountainous districts, originating in the same cause, *the approximation of opposite temperatures.* This is more particularly the case where capes or headlands project considerably into this element, and gave rise to the adage among sailors, "doubling the cape," when they wish to express a thing attended with difficulty.

It is necessary to observe that *the calorific* and *aqueous condensations* of the atmosphere are naturally opposed one to the other; as, by the former, its temperature *is raised,* so by the other it is relieved from its redundance of caloric, or lowered as in the winter, to the point of congelation. Thus *both* cannot possibly take place in the same part of the atmosphere at one and the same time, the commencement of one being that of the dissolution of the other.

Hence it will follow that either of these condensations when in active progression will occasion *winds* or *horizontal currents* in the vicinity of the place where they occur. Thus in warm latitudes, as on the coast of Naples during the summer months, the calorific condensation commences in the morning and gradually increases as the day advances, being more powerfully excited by the *land,* than the neighbouring *sea,* from the superior power of the former in reflecting caloric; and the latter absorbing it in quantity into its depths, as it does in the decomposition of its waters by evapo-

ration in their transition from a fixed to an aëriform state. Thus the steady opposition of the land to the sun's action augmenting the power of this action on the incumbent atmosphere, the consequent superior concentration of its volume, as contrasted with that of the sea, will necessarily occasion a current to flow from the rarefied air of the latter to the former, while its calorific condensation is progressing; and as soon as it ceases with the close of day, the land atmosphere, in assimilating its volume to that of the sea, will, by its gradual enlargement, occasion a counter-current from it to the latter during the night; thus satisfactorily accounting for the *land* and *sea breezes* that during this season succeed each other on this coast with so much regularity.

To this (the calorific condensation) are likewise to be attributed the northern winds that so regularly precede and attend the commencement of summer; (note No. 1,) when this condensation going on southwards, draws in the rarefied air of the pole to supply the vacuum occasioned by its diminution of volume, till the whole of the hemisphere becomes relatively assimilated in temperature. To the same cause are also to be attributed the *trade-winds, monsoons,* and all such periodical winds, probably originating, as those on the coast of Naples, in the localities of oceans and continents connected with the regions of the atmosphere where they occur.

To the *aqueous condensation,* however, it is that the *irregular* and *more violent currents* of the atmosphere owe their origin, for the better understanding which it becomes necessary to refer to its construction. The atmosphere, as mentioned in a former paragraph, being divided in its elevation into different regions or climates, those only *under the curve of congelation* are subject to the influence of this condensation ; as from it to the superficies of the atmosphere, owing to the small proportion of caloric it contains, it may be considered as removed beyond the range of the vicissitudes to which the continual fluctuation of this substance between these opposite condensations exposes the portion of it lying beneath this curve, and consequently its superior region remains in a state comparatively calm and tranquil. The knowledge of this circumstance may not be lost to those who calculate on the possibility of aërostation being at any time made applicable to purposes of use ; as if the region of the atmosphere above the curve of congelation be possessed of a state of rest but little subject to interruption ; the operation of propelling aërostatic machines through such a medium having few obstacles to obstruct it, might be attempted with the greater certainty. (Note, No. 2.)

But to return, there are two causes that appear materially to affect the force of the winds caused by the aqueous condensation. These are *the length of time* from their commencement to their

perfect formation, and the *extent of elevation in the atmosphere* to which they are confined. For the curve of congelation being the limit of their elevation, and this changing its position with the change of the seasons—receding from the earth with the approach of summer, and approximating to it with that of winter ; it follows, that the range of the winds arising from this condensation is occasionally enlarged, or circumscribed, according to the season in which the condensation occurs ; and as a consequence, the energy of the winds will depend on the extent of their range, and the time they take in arriving at a climax. Thus, as waters flowing through a narrow channel acquire an impetuosity proportioned to the circumscribed limits to which they are confined ; so when the curve of congelation suddenly approaches the earth, and the supply of *caloric* in the inferior region of the atmosphere is considerable ; then this condensation proceeds with a rapidity proportioned to the supply of this substance, and of the advance of the opposite temperature causing its condensation: and as it acts on the principle of explosion, the expansion of volume in the air of this region, when both causes mutually combine, is such as to occasion these currents to assume their utmost degree of violence, as was instanced in the memorable gale that ravaged the shores of the Baltic, and caused such destruction to St. Petersburgh on the 19th November, 1824 ; the *frost* (as men-

tioned by the journals of the day) setting in immediately after it.

It follows, as the approach of the curve of congelation in the atmosphere to the earth increases the force of the winds, so the receding or gradual elevation of the curve of congelation has a contrary effect on these phenomena, as is exemplified by their different effects in spring; the increase of warmth at this season dissipating the greater number of these formations in their incipient state, which a slight advance of temperature is sufficient to effect.

On the Effects resulting from SITUATION, *and from the nature of the different Substances composing or appending to the surface of the Earth, in accelerating or retarding the Calorific Condensation of the Atmosphere.*

AT the commencement of the preceding article, it is said that the substances composing the surface or exterior stratum of the globe, or appending thereto, considerably accelerate or diminish the progress, extent, and degree of the calorific condensation of the atmosphere; as *the more susceptible these substances are of absorbing caloric, the less will be their power of reflecting or transmitting it, and* VICE VERSA.

Now as this principle in bodies, together with that of *circumstances connected with location*, acts so important a part in the phenomena of the atmosphere, a more particular inquiry into the nature of the agency of the above-mentioned substances is desirable; it being from a correct knowledge of this that practicable results beneficial to society may be attained.

In Dr. Ure's Dictionary of Chemistry, article *Climate*, is the following passage. "It appears very probable that the climates of European countries were more severe in ancient times than they are at present. Cæsar says that the vine could not be cultivated in Gaul, on account of its

winter cold. The reindeer, now found only in the Zone of Lapland, was then an inhabitant of the Pyrenees. The Tiber was frequently frozen over, and the ground about Rome covered with snow for several weeks together, which almost never happens in our times. The Rhine and the Danube, in the reign of Augustus, were generally frozen over for several months of winter. The barbarians who overran the Roman empire a few centuries afterwards, transported their armies and waggons across the ice of these rivers. The improvement that is continually taking place in the climate of America, proves *that the power of man extends to phenomena, which from the magnitude and variety of their causes, seemed entirely beyond his control.* At Guiana, in South America, within five degrees of the line, the inhabitants living amid immense forests, a century ago, were obliged to alleviate the severity of the cold by evening fires. Even the duration of the rainy season has been shortened by the clearing of the country, and the warmth is so increased, that a fire now would be deemed an annoyance—it thunders continually in the woods; rarely in the cultivated parts."

Thus, in a single view, in the revolution of climates which various countries have undergone by the substitution of cleared land for woods or forests, we behold the effects occasioned by the agency of different substances *composing* or *appending to* the surface of the earth; and we see, at the same

time, the imperfect knowledge which exists of *the nature of this agency*, and the important physical results that may follow from its true explication. This explication, so desirable to science, I have reason to believe will be found in the foregoing principle of the inequality of bodies in their powers of absorbing and reflecting the calorific condensation of the atmosphere.

Now, these powers in bodies appear to depend in a great measure on their peculiar organization or texture; as the more firm or *compact they are, the less* in general will be their powers of absorbing caloric, and *the looser their texture,* or the weaker the bond of affinity which retains such of them in *a fixed,* as are susceptible of being changed into *an elastic aëriform state*, the greater will be those powers.

Consequently *sand*, from its particles possessing a compactness of texture approaching to that of vitrified substances, combined with their *high polish*, causing them, as so many minute mirrors, to reflect the sun's rays, powerfully augments, where it exists in the aggregate, (as in the Deserts of Egypt, *&c.*) the calorific condensation of the atmosphere.

On the same principle, rocky and calcareous soils contribute to produce a like effect, when the sun's action on them is not intercepted by the foliage of woods.

On the contrary, *morasses*, and all species of alluvial soils, from their capacity for absorbing

caloric, necessarily retard and lessen the energy of this condensation.

Still more remarkable in this latter respect is the influence of *forests*, which, receiving the sun's rays on the continually undulating surface composed of their foliage, and thus offering but an imperfect opposition to them, and *breaking their unity*, so far blunt the progress of the calorific condensation as to have occasioned in some of the countries enumerated in the above quotation, such a reaction or fall in their main temperature, as to approximate in some measure the *tropic* with the *pole;* the increase in their main annual temperature there noticed being altogether the effect of the removal of the forests with which they were formerly covered*.

While on this part of the subject, and considering the affinity which exists in bodies, between their powers of reflecting *light* and *caloric*, as well as seeing that *lens* made of *ice* are known to be equally capable as those made of *glass*, to produce *ignition*, by the concentration of the sun's rays passing through them, I cannot help expressing

* This circumstance should have some weight with our transatlantic brethren of *the United States*, in their anxiety to clear the country of its *forests*, particularly in the southern states ; as by clearing the country *of these*, unless *active cultivation of the soil* be substituted in their stead, they may by so doing (as in the case of the Roman Campagna) be preparing the way for the introduction of an evil of much greater magnitude than any that could result from the presence of these forests, which a beneficent Providence raised as a *screen* to protect their inhabitants from the formidable effects of Miasmata.

my opinion, however paradoxical it may appear, that *snow*, while in a perfect state, is not less remarkable for its power of reflecting caloric than light, (Note No. 3,) composed as it is of a mass of minute crystals, the high polish of whose surfaces it is that gives to it in so remarkable a degree the property of reflecting light. As further illustrative of this position, it is remarkable that the dissolution of snow is not effected with *equal facility* by the direct action of the sun's rays, as by the *aqueous condensation*, when it commences in the atmosphere above it; which latter, as mentioned in a former paragraph, destroying *its equilibrium* a double absorption of its caloric appears to take place; the snow beneath imbibing it with equal avidity as the growing condensation above. If this supposition be well-founded, it supplies an additional instance of the economy of nature, in clothing the summits of the loftiest mountains with this substance; thereby increasing their effect in producing the phenomena of the aqueous condensation.

The *circumstances connected with location*, mentioned at the commencement of this article, as exercising an important influence on the calorific condensation of the atmosphere, are those which proceed from *peculiar conformation* and *relative situation* of places on the surface of the earth. Thus, the surface of the ocean, from being the lowest part of the earth's surface, is the *standard level* by which the elevation of mountains, *&c.* ,are

measured, and has, consequently, the greatest height of atmosphere above it; and as the influence of the sun's atmosphere on this body is, *in the inverse ratio of its elevation* (as remarked in a former paragraph), consequently, where its elevation is greatest the sun's action will be most powerful, if the nature of the opposing surface does not diminish its effect. Thus the nearer *land* approximates to the *water level of the earth*, the more powerful will be the action of the sun on it, and the further it departs from this level, the less will naturally be its influence. Again, as the *combined collision of the sun's rays is found to increase their respective energy;* the more places, by their *situation* and *form*, approximate to the one, and contribute to the other, the greater, necessarily, will be the intensity of the calorific condensation of the atmosphere which they will occasion. Consequently, *level extensions of surface*, when they approximate to that of the sea, and oppose, by their latitude, a vertical opposition to the sun's rays, are those situations which have, at all times, been most remarkable for intensity of heat.

Valleys, by the convergence their sides give to the sun's rays, when they bear directly into them, communicate to their action a superior energy to that produced by plains; but such intervals being seldom of long continuance, by reason of the heights they are enclosed with, preventing a continuance of such action, this tendency seldom has

the effect of raising their temperature beyond that of plains in their vicinity.

Mountains, from their conic figure, breaking the combined action of the sun's rays, by occasioning their divergence; as likewise by their elevation, necessarily tend to lessen their effect.

Again, as the calorific condensation of the atmosphere increases during the day with the advance of the sun in his course, being greater *after mid-day*, than *during the forenoon*, it will have the effect, in hilly or mountainous districts, of causing a lower temperature on their *eastern* than *western sides*. And from the imperfect power of water, as contrasted with *land*, in reflecting this condensation; on the same principle, where an *island* or *continent* takes a direction north and south, their western sides will experience a higher temperature than the opposite. This appears to be the true explication of the problem, why *the western sides of all continents are warmer than the eastern.*

The influence exercised by *water*, in its aggregate state, on the calorific condensation and other phenomena of the atmosphere, is still more remarkable and important than that produced by *land*. This partly arises from the superior proportion the former bears to the latter on the surface of the globe; as, from the immensity of its extent, the uniformity of its surface, and the circumstance of its lying so much lower than the continents and islands it encircles; did the bed of

the ocean possess an equal power with the earth in reflecting caloric, such a degree of heat would be generated over a large proportion of the extent of the globe, as would extinguish both vegetable and animal life: whereas, from being so inadequate in this respect, owing to its opposite capacity for imbibing and retaining caloric; and dissipating it by exhalation, it not only enjoys an atmosphere always supportable and salubrious; but has its temperature so regulated, that even in the latitude of St. Helena, there is never such a degree of heat at the elevation of its *peak* as to occasion *thunder;* though always such as to produce almost continued humidity.

The same agent is had recourse to for explaining this singularity in the climate of St. Helena, as that adopted in most other cases in which the phenomena of the atmosphere is not understood; viz., *electricity*, a *conductor* for which is said to exist in the summit of its peak.

Its true cause, however, appears to be the situation of this island, being so far detached from any other land as to be totally dependant on the surrounding ocean for the caloric afloat in its atmosphere; which, from the causes already assigned, never is in sufficient quantity at the elevation of its *peak*, to occasion *aërial combustion*. Thus the *aqueous condensations* so constantly forming there, being attracted in their incipient state, (*when only* they are capable of producing this phenomenon)

by its elevated summit; the chill temperature which invests it, denying a redundance of its chief pabulum, causes these condensations as in a winter temperature, to *mature slowly*, so as to become perfect before they descend to the region of the sea, when the abundance of caloric there, can produce in them no such phenomena.

Another effect resulting from the capacity of water *to imbibe, and combine with* the calorific condensation of the atmosphere, which seems to have been but little attended to, is, that of yielding back as required, the redundance of this principle, which it had imbibed. For, the ocean extending from the *tropics* to the *poles*, and having its waters saturated with heat while within or near the former; and in this state, circulated by its currents north and south, returns to the atmosphere its redundance of this vital principle, in proportion as, from the absence of the sun during the winter seasons, it becomes exhausted of warmth, (Note, No. 4,) thus preventing the destructive consequences to animal and vegetable nature, which otherwise would result to them from the unmitigated rigours of wintry skies; and shewing, in a striking manner, the all-provident views of the CREATOR in his disposition of the universe:—still balancing each principle with its opposite, so as to guard against the effects that would result from the uninterrupted operation of their extremes!

To this principle, in the waters of the ocean, it

is, that *Ireland** and other islands, similarly situated, enjoy, during the winter months, a mildness of climate so far exceeding that which countries lying within the same degrees of latitude in either continent experience; as it is owing to the influence of the sea, in causing the *aqueous condensation*, that this and other islands have so *low* a summer temperature.

* "Ireland, says Humboldt, presents one of the most remarkable examples of the combination of *very mild winters* with *cold summers;* the mean temperature in Hungary for the month of August, is 71.6°, while in Dublin it is only 60.8°. In Belgium and Scotland, the winters are milder than at Milan."—*Chemical Dictionary*, article CLIMATE.

CLOUDS—CLASSIFICATION OF.

I THINK it right here to notice the ingenious classification of these bodies, given by Mr. L. Howard, who divides their *simple* modifications into three classes, *viz.*, the *Cirrus*, the *Cumulus*, and the *Stratus;* to which may be added, a *fourth class*, which I shall denominate the *Super-Cirrus*, or Polar Clouds, from which originate the *Aurora Borealis*.

The *first* and *last* of these, originating in the higher region of the atmosphere, are never the effect of *localities*, but of the change of the seasons, chiefly on the approach of winter, from the *reaction* it occasions in that part of the atmosphere, the gaseous matter of which collapsing on itself, as in the *polar clouds*, causing its condensation, or blending with the oxygen of the inferior region, produces the *Cirrus*, which, being the commencement of extended incipient condensations, is usually the presage of approaching storm and heavy rain.

The *Super-Cirrus*, from the circumstance of its being detached from the inferior region of the atmosphere, is seldom *immediately* followed by such changes in the weather, though, perhaps, the earliest harbinger of approaching winter.

The *Cumulo-cirro-stratus, vel Nimbus*, or rain-

cloud, being simply the consequence of the condensation commenced in the *Cirrus*, requires no particular comment.

The *Cumulus*, *Cirro-Cumulus*, and *Cirro-Stratus*, are usually the remains of the former, or rain-cloud, particularly after storm, and are seen in the evening congregated in masses towards the verge of the horizon.

The *Stratus*, or night-cloud, which, in summer, both precedes and accompanies fair weather, appears to owe its origin to the suspension of the upright or ascending current of the atmosphere (which current will be found treated of more particularly in a subsequent article), in the absence of the sun, when that part of it about the curve of *congelation*, reverting on the region immediately below, and combining with its caloric, forms a sheet of light vapour, which the first rays of the sun are sufficient to dissipate; the harmony, or equipoise, of the atmosphere, not being affected by it.

IMPERFECT CONDENSATIONS OF THE ATMOSPHERE.

In a former page it is stated, that there are *two imperfect*, as well as *two perfect calorific condensations* in the atmosphere. I have so denominated them, from the circumstance of *caloric* (though manifested to the senses in a manner so contradictory) being the *base* of all four. Having, in the foregoing sheets, discussed the principal phenomena of the *perfect* class, I now come to the examination of those produced by the *imperfect*, which, though not so ordinary or extensive in their range as those of the *perfect condensations*, are, nevertheless, very conspicuous in the phenomena of the atmosphere, and most important objects of inquiry, because of the formidable effects occasioned by a particular class of them on the inhabitants of some of the most extensive and finest regions of the earth.

These imperfect condensations of the atmosphere are of the same species as the *aqueous*, of which they may be denominated *modifications;* their imperfect approach to it, as well as the very *dissimilar phenomena* they occasion, being the effect of *location*, arising from the peculiar situation and opposite nature of the gaseous matter composing the different regions of the atmosphere in which

they occur: for, as the aqueous condensation always takes place in *the middle region* of the atmosphere, and draws the supply of pabulum, without which it could not arrive to a perfect state, from the regions composing the opposite extremes in its ascent; so, from the periodical reaction in its volume, occasioned by the absence of the sun during the night, combined with that arising from his *elongation*, gradually taking place from the summer to the winter solstice at either pole, after the calorific condensation *has surcharged its different regions with this fluid;* from this periodical reaction, I say, it is, that without deranging the harmony of its parts, these nocturnal reactions, combined with the circumstance of its excess of *caloric* encountering an opposite temperature at the surface of the earth, and about the curve of congelation, subsiding from the solar excitement of the day, that these imperfect condensations, and the phenomena they occasion, appear to owe their origin. Of these imperfect condensations, I shall first select those of its superior region, the doctrine or study of which has obtained the title of

METEOROLOGY.

The atmosphere, besides its horizontal currents, discussed in a former article, necessarily has an upright, or perpendicular one, by means of which such terrestrious matter as is decomposed

by the agency of the sun, and thus changed from a *fixed* to an *aëriform state,* ascends the atmosphere in combination with *caloric;* such elastic gaseous matter ranging itself at different elevations, proportioned to the comparative specific gravity its particles bear to each other, and thus supplying the loss it is constantly undergoing by absorption, from the various combinations into which its gaseous contents enter. This upright current of the atmosphere is never so active as when, during the heats of summer, its horizontal currents are suspended; as it is then the decomposition of water and other substances is proceeding with most energy, causing a continual stream of aëriform matter to ascend from the surface of the earth during the day, disseminating itself throughout its different regions. This diurnal current of the atmosphere necessarily ceasing with the cause that produced it, after the disappearance of the sun, the particles composing the different regions of its elastic body being suddenly changed from a state of excitement to one of rest, *recoil on each other,* as the attractive force of the sun is succeeded by that of gravity; the more inflammable species which compose its superior region, feeling this re-action in the same manner as those of its lower, and being at this season comparatively surcharged with caloric, the frigid region of the atmosphere recoiling towards the earth, in the absence of the sun, aiding this re-action of its par-

ticles, a condensation of their volume is effected. But the mass of the air of the superior region of the atmosphere being inflammable hydrogen, with probably a very small proportion of oxygen (owing to the superior gravity of the latter), the redundant proportion of hydrogen has the double effect of preventing this (which I shall denominate the *meteoric condensation*) from approaching beyond a certain point to the *aqueous*, and of causing a slighter compression of its volume to produce ignition than in that of the *thunder-cloud*, in which the relative proportions of oxygen and hydrogen are correctly adjusted to each other.

Thus from the comparative absence of the chief pabulum of combustion, (oxygen) and the redundance of inflammable air in the condensations of this region, when they occasion *ignition*, it necessarily occurs in the highest or *more inflammable part*, and being circumscribed to the point where it originates, from the imperfect nature of the surrounding condensation, it glances rapidly downwards, and following the stream of oxygen, till it arrives at the extreme verge to which the condensation has descended, it disappears; extinguished by the warm air of the inferior region, which, from the meteoric condensation not having reached, remains unaltered in its volume.

If these premises be correct, two important facts in the theory of meteorology and aërial combustion are deducible from them; namely, that

ignition in the phenomena of the atmosphere is always the effect of a compression or condensation of its volume; and that the meteoric condensation is ordinarily circumscribed in its range to that portion of the atmosphere, where the inflammable gaseous matter of its superior region *commences*, and the ordinary atmospheric air of its inferior region *terminates*, when its body is harmonious in the adjustment of its parts. It will likewise follow, as *caloric* is the base of the meteoric condensation, just as it is of the aqueous, that the more abundant it is in the superior region of the atmosphere the more rapid will be the progress of this condensation, and consequently the more numerous and vivid the explosions it will give birth to. This, I believe, will be found in accordance with the history of these phenomena; and I have never seen so numerous and beautiful a display of them as at *Naples*, during the autumn of 1823, particularly *when the heats were greatest*. They were of different shades and brilliancy, from the most vivid silvery white to depths of tint approaching to a fiery glow: the former in general glancing horizontally; the latter shooting obliquely downwards.

AURORA BOREALIS AND AUSTRALIS.

The foregoing theory of meteors will make that of the most singular and beautiful class of them, *viz.*, the *Aurora Borealis* and *Australis,* easy of explication; as these phenomena making their appearance only at stated periods, in particular quarters of the heavens, and when the harmony of the atmosphere is undisturbed, seem to point out in a more distinct manner than those of the former class the cause from which they proceed.

It is a well-known fact that the *Aurora* appears only in the autumn and beginning of winter, when after the atmosphere has been most charged with caloric, and by the gradual elongation from and final *reversion of either pole to the sun,* a collapse of this fluid from that part of its superficies in the direction of the tropics, takes place, on the advance of the frigid region of the atmosphere in those parts of the heavens, as the sun recedes from them. Such combined movement in the same direction of these opposite principles in the atmosphere, by causing a concentration of the caloric and inflammable gaseous matter of its superior region, will sufficiently account for the formation at these seasons, at either

pole, of those *meteoric clouds*, from whose base, as from a battery, their sportive corruscations are discharged, describing in their flight a slight but regular curve, conformable to the extended figure of these condensations, which appear to be regulated in this respect by that of the earth itself*.

The causes that appear to make the phenomena of the *Aurora Borealis* and *Australis* dissimilar from the ordinary class of meteors, both in the manner of their appearance and peculiar movement, are that the caloric of either pole thus retiring on its body, in the direction of the equator, necessarily assumes greater regularity in its movement, than what can be produced by the momentary nocturnal reactions in the atmosphere, which occasion ordinary meteors. This movement having the effect of making them more dense on the side of the equator than at their superficies, in the opposite direction, will account for their conformation being more determinate, on which their mode of explosion, and the movement described by their corruscations seems to depend. Add to this, that the superior intensity of cold contributes to make these condensations *more perfect* than those of ordinary meteors, inso-

* Their common form, says a late writer who observed them from Greenland, *is arched*, in a direction from E.N.E. to W.S.W. (See *Monthly Magazine* for October, 1824, p. 234.)

much that they become *distinctly visible;* which is never the case in those condensations that originate the ordinary class of meteors, the atmosphere at such times rarely undergoing more than a slight diminution in its transparency.

METEOROLITES.

Before quitting the subject of *meteors*, I think it right to offer some observations on those remarkable bodies produced by some of them, and which from this circumstance are called *Meteorolites*. These, were there no other proof of the profound ignorance that exists not only of the powerful agency exercised by the atmosphere in the decomposition of *terrestrious matter*, but of the true theory of the atmosphere, as exemplified in the production of these substances, were sufficiently conclusive.

In accounting for these singular productions, it appears no further progress has been made, than what we find in the following excerpt, taken from the last edition of Dr. Ure's *Dict. of Chem.*, in the article *Combustion*:—"The facts on rarefaction of inflammable gases shew, that the luminous appearances of shooting stars and meteors cannot be owing to any inflammation of *elastic* fluids, but must depend on the ignition of *solid* bodies. Dr. Halley calculated the height of a meteor at ninety miles, and the great American meteor, which threw down showers of stones, was estimated at seventeen miles high. The velocity of motion of these bodies must in all cases be immensely great, and the heat produced by the compression of the

most rarefied air, from the velocity of motion, must be probably sufficient to ignite the mass. *All the phenomena may be explained, if falling stars be supposed to be small solid bodies moving round the earth in very eccentric orbits, which become ignited only when they pass with immense velocity through the upper regions of the atmosphere; and if the meteoric bodies which throw down stones with explosions, be supposed to be similar bodies which contain either combustible or elastic matter.*"

To suppose that these meteoric bodies could exist in a *detached state, moving round the earth*, and the velocity of their motion be such as to *ignite the mass*, required a capacity for the *marvellous* in those who could suppose it, as, were it not thus seriously promulgated in a work of such authority, I could not have thought possible in the *cognoscenti* of our times; and furnishes a remarkable proof of the extravagancies into which the want of a knowledge of *the true principles of science* will lead even the most enlightened men. As well might they suppose that *hailstones* moved round the earth in very eccentric orbits, and that it was their explosion that produced the phenomena of thunder and lightning, *&c.* Besides, what power is it from which they could receive such an impetus as would cause their *ignition?* And what *after their explosion* in producing those meteors from whose bosom they are observed to descend, could *re-unite their parts*, and restore them to the

earth in this state? But the thing is too absurd to need further comment.

Is it not more consonant to reason to suppose, that the matter of which they are composed had been wafted in an *aëriform state* to the superior region of the atmosphere, of which it formed a part, and derived from the decomposition of terrestrious matter, (probably fluids,) in which it existed in a state of solution, by means of the sun's agency? This matter being changed from its *elastic state*, by the action of combustion, occasioned by the *meteoric condensation* in this region, into a state of *fusion*, and the combustion causing a *void* in the body of such meteors; at the instant of their explosion the surrounding atmosphere rushing with the celerity of lightning into it, carries to its *centre* the atoms thus glowing in a state of fusion, where united as in a *mould* by the equal compression of the exterior atmosphere, they adhere together; forming *a coherent aggregate*, and in this state, by the action of gravity, are precipitated on the earth, exhibiting by their glowing warmth, at the moment of their fall, the recent state of fusion from which they have passed.

MEPHITIC CONDENSATIONS OF THE ATMOSPHERE.

HAVING in the foregoing sheets treated of the *two perfect* condensations of the atmosphere, together with the phenomena they occasion; and of the phenomena produced by the *imperfect condensation* in the superior regions, I now come to those occasioned by the *imperfect condensation* in the *lower* region of the atmosphere, or that next the surface of the earth. These constitute the original cause of the present inquiry, and by reason of their deleterious effects on animal life, I have denominated them *the mephitic condensatians* of the atmosphere.

This class of aërial condensations (as mentioned in a former page) are of the same nature as *the meteoric*, viz., modifications of the *aqueous*, the principle of their formation being the same, and their different phenomena being the effect of local causes, arising from a difference in the gaseous medium of the regions of the atmosphere in which they occur. They are divisible into three heads, *Fog, Dew, Miasmata.*

FOG.

When terrestrious bodies in the aggregate possess a redundance of *caloric*, over that of the super-

incumbent atmosphere coming in contact with them, the principle between approximate bodies of equalizing their temperature, until a common standard be established among them, occasions an escape of such redundance from such terrestrious bodies into the atmosphere above them, until the temperature of both these bodies be assimilated. The *first effect* of such evolution of caloric into an atmosphere attenuated and cold, being an approximation of *these opposite temperatures*, will occasion, as in the *perfect aqueous*, a condensation in their volume, which from the redundant proportion oxygen bears to hydrogen in this region of the atmosphere, prevents such formations from advancing beyond a certain degree of condensation. This condensation being chiefly a compound of *oxygen* and *caloric*, and changing the volume of this stratum into a dense vapour, is called *fog*, the deleterious effects of which on animals arises from neutralizing or changing so large a proportion of the oxygen of this region from an *elastic aëriform into a fixed state*.

To this cause is to be attributed these phenomena in the polar and other seas, when the first approach of winter brings the attenuated air of this season in contact with the surface of the ocean. The same will, occasionally, be produced on mornings succeeding slight frosts, or heavy falls of dew, by their absorption of caloric from the lower stratum of the atmosphere in decomposing

them. For such absorption necessarily chilling this stratum while it proceeds, and being acted on by that immediately above it, the approximation of the opposite temperatures will, as in the former case, produce these phenomena, until the increasing heat dissipates them.

These phenomena are likewise produced when opposite currents in the lower region of the atmosphere encounter and blend with each other, particularly when (as in those of the north and south) their temperatures are different; and usually precede the changes of weather attendant on that of the summer and winter seasons.

It is worthy remark that the *water* formed by the deposits of this condensation in the atmosphere is dissipated by exhalation, with apparently more facility than *ordinary water*, owing, probably, to *the attraction of aggregation* being weaker between the particles of one formation than between those of the other, from the deficiency of hydrogen in the former compared to that of the latter.

DEW.

"Dew, according to Aristotle, is a species of rain, formed in the lower atmosphere, in consequence of *its moisture* being condensed by the cold of the night into minute drops." Again, "Aristotle justly remarked, that dew appears only on

calm and clear nights. Dr. Wells shews that very little is ever deposited in opposite circumstances, and *that little* only when the clouds are very high. It is never seen on nights both cloudy and windy; and if, in the course of the night, the weather, from being serene, should become dark and stormy, dew which had been deposited will disappear. In calm weather, if the sky be partially covered with clouds, more dew will appear than if it were entirely uncovered."—*Dr. Ure's Dict. of Chem.*—Article, *Dew.*

The above extracts appear to combine in them all the *real light* which science has hitherto been able to shed on this phenomenon; and which amounts simply to a description of the state of the atmosphere on the nights when it is observed to form, without in any way accounting for its formation and appearance at these particular times. Saying that it is *in consequence of the moisture of the lower region of the air being condensed by the cold of the night into minute drops,* amounts to nothing; since no account is given *how this moisture comes into this region,* which, but a few hours before, had been *dry and warm;* and in this state the explication of it must have remained, until a more perfect knowledge of *the principles* that govern the phenomena of the atmosphere was obtained.

These extracts, however, though they say nothing as to the principle of the formation of dew, corroborate, in the fullest manner, the positions

laid down in the foregoing pages, *viz.*, that the two main or perfect condensations of the atmosphere, *the calorific* and *the aqueous*, are essentially opposed one to the other; insomuch, that the commencement of the one is, in the region where it occurs, that of the dissolution of the other; that the *imperfect condensations* of the atmosphere only occur when the different regions constituting its body are harmoniously adjusted to each other along the scale of its elevation; and that these imperfect condensations, though they occur in its extreme regions at one and the same time, never disturb its harmonious equipoise. They likewise shew that the *aqueous condensation*, when it commences, is not only opposed to the *calorific*, but also to *these imperfect condensations;* for if the formation of *clouds*, with their concomitant *winds*, which attest the commencement of this phenomenon, happens to occur on nights in the commencement of which *dew has been deposited, it will disappear;* thus proving, by the testimony of observation coeval with the dawn of science, the close coincidence that exists between the circumstances connected with the history of these phenomena, *and those that result from the principles* on which the present theory of the atmosphere has been founded.

Thus when during the heats of summer, the atmosphere is *harmonious and serene*, after the disappearance of the sun, *the earth* quickly evolving the caloric it had imbibed during the day, falls many

degrees in its temperature ; while the atmosphere, from its superior elasticity and specific lightness, retains, with little diminution, the concentration of caloric produced by the sun in its lower region during the day. Thus as the temperature of the earth falls, a difference between it and that of the atmosphere commences ; and this collision of their opposite temperatures occasions a condensation to commence in the stratum of the atmosphere pressing on the earth. This condensation, the redundance of caloric, with which it is saturated, accelerates ; thereby changing this stratum into a sheet of subtile vapour. The caloric of this stratum being thus absorbed, that immediately above it, from the *action of the cold beneath,* undergoes a similar change. In this manner the *mephitic condensation,* commencing at the surface of the earth, gradually ascends to some elevation in the atmosphere, until the mass of vapour which it generates, intercepting the chilling influence of the earth, this influence becomes gradually diminished, until, at a certain elevation, it ceases to operate : and the vapour thus generated, recoiling, by its superior specific gravity, descends imperceptibly to the earth ; where, gradually accumulating, it hangs in pendent drops on the vegetable or other substances which it meets with—*in dew.*

Thus, in proportion to the quantity of caloric with which the lower region of the atmosphere is charged at such times, and of the facility with

which the opposing stratum of the earth evolves its caloric, or cools, will be *the degrees of acceleration, and the quantity of dew deposited by these condensations.*

That the sudden change of temperature in the earth, in the absence of the sun, is the real cause of dew, is proved by the circumstance that, at the time in which it forms with most facility and in greatest quantity *on land,* this condensation goes on so slow in the same latitude *at sea,* and in its vicinity, as to be scarcely perceptible. This difference arises from the superior capacity of *water* to that of *land* for imbibing and retaining caloric. The sea, when the sun disappears, preserving its temperature nearly in the same proportion as the atmosphere, the difference between their relative temperatures goes on so slowly, that the slight condensation *in the latter,* which it occasions, is hardly perceptible, as, of consequence, is the change in its temperature, on which it depends. The effect of the *sea* on the *atmosphere,* within the range of the *trade winds,* may be, as I am informed it is, different, as to the formation of dew, as these winds may have the same effect as *land* in chilling its lower region.

MIASMATA.

Miasmata are thus defined by Dr. Ure, in his Chemical Dictionary:—"Vapours, or effluvia, which,

by their application to the human system, are capable of exciting various diseases, of which the principal are intermittent, remittent, and yellow fevers, dysentery, and typhus. That of the last is generated in the human body itself, and is sometimes called the typhoid fomes. The other miasmata are produced from moist vegetable matter in some unknown state of decomposition. The contagious *virus* of the plague, small-pox, measles, chin-cough, cynanche maligna, and scarlet fever, as well as of typhus and the gaol fever, operates to a much more limited distance through the intermedium of the atmosphere, than the marsh miasmata. Contact of a diseased person is said to be necessary for the communication of plague ; and approach within two or three yards of him, for that of typhus. The Walcheren miasmata extended their pestilential influence to vessels riding at anchor, fully a quarter of a mile from the shore.

" The chemical nature of all these poisonous effluvia is little understood. They undoubtedly consist, however, of hydrogen, united with sulphur, phosphorus, carbon, and azote, in unknown proportions, and unknown states of combination."

Thus, it appears, *Miasmata* are of two species, *viz.*, the *animal* and *terrestrious*, which some assert to be *totally distinct* in their origin and nature. To the diseases occasioned by the former is applied the term *epidemic ;* to those of the latter *endemic.*

" To the former is assigned those generally pre-

vailing diseases, most commonly of the febrile class, which are communicated by the morbid effluvia of the living human body; to the other, those which proceed from the exhalations of the soil. To the former, *contagious diseases belong*, such as small-pox and *plague;* to the latter, agues or intermittent fevers, which are never contagious*."

In discussing the subject of Miasmata, it is necessary to bear in mind the distinct meanings attached to the terms epidemic and endemic, as they are not unfrequently misapplied one for the other; some asserting that particular diseases belong to the one, and some, with equal confidence, that they belong to the other class. But, as is the case in the colours of the *Iris*, it is not easy to determine the exact point where one terminates or the other begins; notwithstanding the pertinacity with which each party, in the discussion of the question, as to the precise limits assignable to each, maintain their opinions. Perhaps, as in the phenomenon of the Iris, the *agent*, that on its superior side gave us the perception of a *particular tint*, was precisely the same that occasioned all the diversity observable, *by its further progression*. Indeed, I see no reason why *some en-*

* I profess myself indebted for the above definition of these terms, to an ably-written article in one of the public journals of this city, occasioned by the late discussions on the Quarantine Laws.

demic diseases, commencing in *terrestrious Miasmata,* should not *be the cause* of generating *the morbid effluvia of the living human body,* which originate the *epidemic.* Thus it is by no means a decided point whether the *plague* does not originate in the *endemic* class, though afterwards it may partake of the nature of the *epidemic,* which appears to be extremely probable. But leaving this to the decision of others, I shall confine my inquiry to the cause of the *terrestrious Miasmata,* from which, as is admitted by all parties, the *endemic* class of diseases take their origin.

Though sensible heat, to a certain extent in the atmosphere, be indispensable to the production of terrestrious Miasmata, yet it is known that the extreme point of temperature to which climate attains, is not capable, in certain situations, (such as the Sandy Deserts of Egypt, and all places so circumstanced, where the calorific condensation has no, or but a small portion of, decomposable matter to act on) to produce Miasmata. It follows that the human constitution being exposed to the action of a high atmospheric temperature, derives no further injury than what an equal temperature conveyed to it by *water,* or any other innoxious medium, would occasion. Consequently, though *heat* be necessary to the production of Miasmata, it cannot, without the co-operation of particular substances, originate them; and hence the circumstance of their being in their extent confined to

particular districts, which furnish, in a greater or less degree, these substances; as, likewise, to particular seasons and latitudes, which supply the requisite degrees of atmospheric temperature necessary to their production.

These facts naturally lead to an examination of the *situations* and *latitudes* in which those enemies to human life manifest themselves; and here we shall find that their effects are not only varied by the substances, from the decomposition of which they proceed, but from the different degrees of excitement to which these substances are exposed.

Thus, it appears, that what in England occasions but the *ordinary ague* or the *typhus fever*, (as I am of opinion that this latter disease is as much induced by an impure state of the atmosphere, as by the use individually of improper aliment) in Italy, is the cause of anaggravated species of *intermittent fever*, attended with dropsical swellings, and generally terminating in death:—in Spain, the West Indies, and part of America, *the yellow fever;* and in Egypt, Asia Minor, *&c.*, the *plague.*

In examining the situations most remarkable for these diseases, we shall invariably find they are such, as where the soil having been for the greater part of the year saturated with water, necessarily holds in a state of solution combined with it, a proportion of the soluble substances (chiefly vegetable) of which it is composed; or where soils of *superior fertility* are for a considera-

ble time exposed to the action of a high atmospheric temperature.

In both cases, they appear to be the result of a species of fermentation in the mass of these soils; or if in marshes, in the stagnant waters composing them being saturated with animal or vegetable matter in a state of solution brought on by the compounds they form, imbibing from the atmosphere caloric to a certain extent, which, acting on the more volatile matter composing the animal or vegetable substance, by its decomposition in changing from a fixed to an aëriform state, is evolved into the lower region of the atmosphere.

Thus, in attending the calorific condensation through its course, from its commencement in spring, first we behold it awaking the vegetable kingdom into life, and clothing the fields with verdure; next, by its increase, maturing the various products of spring; then by its excess, withering that vegetation which it first called into being, and continuing its agency on the soil, the *carbon* and *azote* of which being imbibed by its vegetable products, while they are advancing to maturity, are *neutralized* by assuming *a fixed state* in their composition; but being deprived of their salubrious effect with their presence, the excitement continuing, this deleterious matter becomes (as stated in the foregoing paragraph) sublimated in a gaseous and crude state into the lower region of the atmosphere.

Up to this point I found it facile to trace the history of Miasmata; but here the lights that guided me so far, on a sudden disappeared, leaving its further explication involved in mystery. This obliged me to examine more particularly the principles that govern the phenomena of the atmosphere, as I found the explication of some circumstances connected with the history of Miasmata impossible on the principles which have guided the researches of others. The result has been the adoption of the principles on which I have ventured to found the present theory, and which pointed out to me the new combinations, and the essential changes *in their physical properties*, occasioned by these combinations, which the gaseous matter, composing the atmosphere, is made to undergo by the periodical change in particular latitudes, during their summer seasons, from a state of *calorific excitement* to that of *rest*, in the revolution of each 24 hours.

Thus, I perceived that in situations where the climate temperature is high, but the opposing stratum of the earth proportionally absorbent, though the mephitic condensation may proceed with rapidity, and precipitate copious dewy deposites, it has no farther deleterious effect on the human body exposed to it, than what, under similar circumstances, would be occasioned by *fog*, which never appears but when the atmosphere is of a moderate temperature; if the body (as is usual

after being unbraced by the action of a high temperature during the day) had been exposed on a sudden to its chilling influence: whereas, when to the oxygen and caloric of the lower stratum of the atmosphere are superadded *carbon, azote, hydrogen, phosphorus, &c.*, which, held from each other in a detached state during the day, by the agency of the calorific condensation, when succeeded at the close of it by *the mephitic*, these pestilential effluvia, which, an hour before, while in a simple aëriform state, were comparatively innoxious, on a sudden, by the new combinations they form in the mephitic condensation, by neutralizing in this new compound the greater part of the caloric and oxygen of this stratum of the atmosphere, assimilates it in its destructive properties to the species of vapour known to the miners by the appellation of the *choke damp*, which, imbibed by the lungs or pores of the skin, and incorporated with the *living human body*, deranges the entire of its vital economy.

Thus the species of mephitic condensation that originates Miasmata, will manifest their effect according to the peculiarities not only connected with the degrees of malignancy of the effluvia composing the integrant parts of such condensations, but as circumstances connected with individual constitution, and of the actual condition of the body at the time of being exposed to their influence, may tend to lessen or increase; as when

these circumstances concur to give them all their destructive effect, Miasmata have been known to extinguish human life with the same celerity as the *damp* alluded to in the foregoing paragraph*.

From this review it will appear that the *theory of dew* is that of Miasmata, differing only from the latter in circumstances connected with location, arising from the nature of the decomposable matter which the agency of caloric, from *a fixed*, sublimates in an *aëriform state* into the atmosphere.

* " En été, il fait dans ces vallons une chaleur étouffante pendant le jour, et au coucher du soleil un froid subit insupportable. Les pauvres ouvriers mal vêtus, mal nourris, et encore plus mal conseillés, se couchent quelquefois sur l'herbe pour se rafraichir, *et en meurent.*" Voyage dans le Latium, par M de Bonstetten, p. 260.

" *Subcarburetted hydrogen.*—This gas is supposed to be procured in a state of definite composition, *from the mud of stagnant pools or ditches.*" " The *fire damp of mines is a similar gas to that of ditches.*" *Dic. of Chem.*, article *Carburetted hydrogen Gas.*

SHIP MIASMATA.

As I cannot conclude my inquiry into the nature and cause of Miasmata, in a manner more congenial to my feelings, than by making it not only instrumental in promoting the interests of humanity generally, but of those of my country in particular, I shall esteem any time or industry I have devoted to the explication of this subject as abundantly repaid, should the suggestions I am about to offer for the prevention of the diseases *they* occasion in the *Navy* be attended with success.

Two circumstances prove that the *yellow fever* so prevalent in the navy in the East and West Indies, and which robs the country of such numbers of her gallant defenders, is occasioned by Miasmata; the first is its not being an *epidemic* disease; the second, that in the crews of different ships on the same station, while among some this disease rages with its accustomed virulence, others escape altogether this frightful visitation, preserving their health unimpaired.

That these Miasmata originate in the defective state of the ships where they manifest themselves, admits of little doubt, being generated in their

interiors by the corrosive action of the sea-water on wood or other substances it comes in contact with; the mutual action of which on each other is accelerated by the agency of caloric, causing a partial decomposition of both, from which they proceed.

The effectual means of preventing this species of Miasmata, necessarily is that of removing their cause; but as this is not always practicable, whether from the state of the ships, or from circumstances connected with the climates, two modes present themselves, which if not altogether effectual would materially diminish their effects. These are contriving a better mode, if possible, than the present for ventilating ships on these stations; and as the power of *charcoal*, particularly that made from *box-wood*, is known to be greater than that of any other substance which can be obtained with equal facility of *absorbing* and therefore neutralizing *all gaseous matter*, by means of a slight and shallow framing of wood, or a netting attached to the *under side* of the lower decks and thus suspended immediately *over the holds*, from which these Miasmata proceed. *A stratum of charcoal* might be placed so as to intercept all that might be generated, and thus such a *cordon sanataire* be established as would effectually protect the health of their crews from this *invisible enemy*. And as charcoal, after a certain time, becomes saturated with the gaseous matter it imbibes, when

this should be found to be the case, *new* might be substituted.

Such an appendage to ships destined for those seas, without in any way interfering with the management of them, would (I have little doubt), by wise prevention, do more to secure the health of their crews than all their surgeons could effect, backed by *the artillery of their medicine chests:* and thus with little cost or trouble would the lives of some of her bravest sons be preserved to their country*.

It is probable that something on this principle might also be contrived to neutralise the Miasmata of *hospitals and prisons*, which in the former are well known to have an injurious effect on their inmates ; and in the latter of sometimes causing a pestilential disease, known by the name of the *gaol fever*, which has often proved as destructive as the plague to those coming within the range of their influence.

* As illustrative of the extraordinary property of charcoal in neutralizing the effects of Miasmata by their absorption, I give the following extract from the " Memoir of Sicily and its Islands," by Captain Wm. Smyth, R.N. London, 1824, p. 97. " *St. Agata* is a town and hamlet on the beach of a fertile country, excessively afflicted with *mal 'aria, except in a few places where charcoal is made.*" This needs no comment.

NOTES TO THE FIRST PART.

Note 1.—I have reason to suppose, that at this season, (the beginning of summer,) when the eastern winds prevail in the lower region of the atmosphere, they are occasioned by the influence of *local causes;* and that the main current of the atmosphere at such times is from the north. This I have seen exemplified on the afternoon of Tuesday the 31st of May, in the ascent made by Mr. Graham from the neighbourhood of Chelsea. There being a light breeze from the east at the time, the balloon was carried for some time westward; but when it attained a greater elevation, it took a direction *due south*, which it continued till the time of his descent; the east wind still continuing below.

I think it right also, by way of further illustrating the effect produced on the body of the atmosphere by the calorific condensation, to notice the comparative shortness of *the twilight* in tropical skies, to that in the regions approximating to the poles. This seems to imply, *that the calorific condensation in compressing the lower regions of the atmosphere, has the effect of diminishing its elevation:* as the greater rotundity of the earth at the tropics, and the contraction of angle of the sun's rays with the atmosphere which it occasions, combined with that of *their direct* rather than *oblique action*, will hardly account for this difference.

Note 2.—Without wishing to be considered in the

number of those who consider it certain that *aërostation* will ultimately be added to the list of sciences beneficial to society, I cannot help observing, that the principle on which it has hitherto been attempted is *a wrong one;* inasmuch, as from the subtile, expansive, and inflammable nature of the gas used for inflating balloons, they are subjected to the risk of being precipitated by explosion, or the inconvenience of being prevented from continuing but for a short time suspended in the atmosphere, by the gradual escape of the gas. The reason why *hydrogen gas* is preferred in balloons, is *its great specific lightness,* which gives to it a buoyancy superior to the other gaseous matter of the atmosphere. But as the quality for which it is so esteemed, is that of *being less material* than any hitherto-discovered substance; why not substitute for it in aërial ascents, *the absence of material substances,* or *a vacuum?* for, however light hydrogen gas, as compared with atmospheric air, is, it nevertheless weighs about forty grains the cubic foot; which necessarily would give to *a perfect vacuum* an additional ascensional force of *forty grains per cubic foot, more than the hydrogen gas.* Thus, if a metallic or other hollow sphere of proportionate dimensions could be contrived, of a specific gravity *less* than that of a like number of cubic feet of atmospheric air; and by the operation of the air-pump had its interior converted into a perfect vacuum; it would necessarily become buoyant in the atmosphere, and in proportion to the difference between its specific gravity and that of the same amount of atmospheric air, would elevate with it any weight under such difference. The consequence would be, that the exterior pressure of the atmosphere (the only thing to be provided against) being greatest in its lower region, the higher it ascended, the more secure from accident it would

become; and that instead of being constrained to descend in a few hours, at the utmost, as at present, a balloon so contrived could be *kept suspended in the atmosphere any length of time* at pleasure without incurring risk of any kind.

Should partial success ever be attained to in this science, it is not difficult to foresee, that it must be by the adoption of this principle.

Note 3.—I had a rather memorable instance of the power here attributed to *snow*, of reflecting caloric and exciting the aqueous condensation of the atmosphere, in crossing the *Alps* by the road of the *Simplon* in the spring of 1824. *Domo d'Ossola* is the last stage on the side of Italy before arriving at the village of the Simplon, from which this passage of the Alps takes its name. Having left it some time before day on the 17th of April, as the morning advanced, the sky being serene and clear (after we had entered on the snow that covered the road to the depth of four or five feet, from the *house of Refuge*, No. 9 on that side, to the descent to *Brigg*, in Switzerland,) notwithstanding the great elevation of this part of the road, and the *shining waste* extending on every side, the warmth was very considerable during the forenoon, at which time the sky became suddenly changed, and shortly after the rain began to fall. It increased as the evening closed, accompanied with a gale of wind, which blew a hurricane during the night, and continued accompanied with snow and sleet till noon on the following day.

It is easy to conceive, that amid the stupendous features of the surrounding scenery, the effect of this tempest was awfully sublime. It was such a scene of "elemental strife,"—now enveloping in its dark skirts,

now half-revealing through their rents, the majestic summit of each neighbouring Alp—as the genius of a *Shakspeare* might contemplate and delight in!

Note 4.—In Doctor Marcet's valuable Dissertation on Sea-water, published in the *Philosophical Transactions* for 1819. This philosopher shews, "that in Baffin's-Bay, the Mediterranean sea, and the tropical seas, the *temperature* of the sea *diminishes with the depth*, according to the observations of Phipps, Ross, Parry, Sabine, Saussure, Ellis and Peron; but that in the Arctic or Greenland seas, the *temperature* of the sea *increases with the depth*." These facts not only prove that the currents of the tropical seas extend to those of the Arctic regions, but also the wise and beneficent intentions of providence here alluded to, of conveying by means of these currents to the poles, a portion of the warmth of the tropics; and from the former to the latter, a portion of their *cold* to temper the fervour of their scorching atmosphere. It must be admitted, however, that the *caloric* thus conveyed to the Polar seas, is the chief source of the violent tempests by which they are swept during the winter season, encountering, as it does, the frigid region of the atmosphere suspended immediately above it.

SECOND PART.

" Se tanto in onore vi fosse *l'agricoltura* quanto l' architettura ; se diviso non fosse il paese in tanti governi diversi, tutti di varia forma, e quasi tutti deboli, e poco estesi non si vedrebbe la miseria al fianco della magnificenza, e l' industria senza attività ; ma per somma disgrazia più si è atteso all' abbellimento delle città, che alla cultura delle campagne, e dappertutto gl' incolti terreni rimproverano agli abitanti la loro infingardaggine."—*Ganganelli al Signor Abate Ferghen.*

SECOND PART.

The Effects of Miasmata, more particularly as exemplified in the former and present State of the Campagna di Roma.

If instances were necessary to prove the evils of Miasmata, by the waste of human life which they occasion in districts subject to their visitations, it were unnecessary for illustration to go beyond *the fens of Lincolnshire* and Essex. These are only indebted for the degree of salubrity they possess to the usually cool temperature of an English atmosphere. Yet, even with this advantage, the proportion of those whose avocations oblige them to dwell in these fens during the warm season, that become victims of disease occasioned by this "invisible enemy," amply attest their malignant effect on the human constitution.

Still more impressive is the instance furnished by the *Walcheren expedition*, where Miasmata proved more destructive to the ranks of a brave army than the swords of the enemy.

Africa, America, Spain, *&c.*, by the number of victims annually swept off by this scourge in the

shape of plague, yellow fever, *&c.*, at the same time that they shew the wide range and destructive effects of Miasmata, likewise prove the ignorance which prevails as to their origin and true nature; there being but few instances of any beneficial change being effected in districts subject to their presence, by the remedies hitherto resorted to: and hence the necessity of investigating the source of so destructive an evil.

Rome, however, and its *campagna*, furnish an instance of the effects of Miasmata, which, of all others, perhaps, excites, from the number of associations connected with them, the most general and lively interest: that Campagna, heretofore the residence of *fifty-three colonies*, each of which was able, when occasion required, to bring its army into the field; and which, subsequently the seat of empire for so many ages, gave birth to a city the most renowned in the world both for power and the extent of its population; but which, at present, from the effects of Miasmata, sees its fine territory stripped of inhabitants, and from being the garden of Italy, converted into a frightful desert, while it beholds the splendid monuments of its metropolis, the ancient capital of the world, only prevented from becoming the same as those of *Palmyra*, by the influx of strangers, occasioned by its being the residence of the assumed head of the Christian religion, the school of the *fine arts*, and the seat of an independent government.

Having resided there for nearly a year, during which I took considerable pains to investigate the source and nature of Miasmata; and having discovered, in some interviews I had with scientific persons resident there, the almost total ignorance that prevails respecting them, I was induced to make a communication to the late *Cardinal Consalvi*, then Minister to *Pius the Seventh.* This I made through the medium of Her Grace *the late Duchess of Devonshire*, who, with her accustomed attention to the calls of humanity, thinking that it might be the means of doing good, most readily lent her good offices. This communication drew from His Eminence a letter of thanks, still in my possession. But the death of the Pope shortly after, with the changes it occasioned in the government, and, subsequently, of Cardinal Consalvi himself, put an end to any expectation I might have entertained of seeing the plan I had projected carried into effect.

This plan, which took me some time to digest (and which will be found inserted at the conclusion of this part), I deposited in the hands of the noble Marquess to whom this work is dedicated, and who (then resident at Rome), having concurred with me in the views I took both of the nature of the evil, and of the means I proposed for its removal from the Campagna, in some interviews he honoured me with, was induced, at my request, to use his influence with the Roman government, to attend to the suggestions it contained. But the

unexpected death of Cardinal Consalvi, as before mentioned, interfered; and he being the only person connected with the Roman government at the time that was likely to interest himself in the business, caused this design to be abandoned.

Conceiving, however, that inquiry into the cause of an evil of such magnitude was one which the interests of society made desirable, I was induced to compile the present work. Thus did the circumstances connected with Rome and its Campagna, that first fixed my attention to this subject, no longer exist but in their history, it would not make me the less desirous to add my feeble aid in this particular towards the general good.

Should another *Braschi* (Pius the Sixth) be raised to the pontificate, perhaps the suggestions here given may not be in vain in bringing about the regeneration of this highly-favoured region: for the better understanding the localities of which, and of the present state of knowledge on the subject, I have thought it necessary to make such extracts from the writings of others, as would place these points in a true light *.

Monsieur de Bonstetten, in his excellent work entitled "Voyage dans le Latium," has given the

* The *Campagna di Roma* comprises but a part of what is called the *Maremma,* or that part of the western coast of Italy that, by reason of its insalubrity, is nearly stripped of inhabitants; a considerable part of it lying in the territory of the Grand Duke of Tuscany to the north, and some, likewise, to the south, in the

following topographical *coup d'œil* of this celebrated region, for the accuracy of which I can vouch.

" La Ville de Rome est placée à environ six lieues des montagnes calcaires *de la Sabine*, qui forment une chaîne contigüe assez ressemblante au Jura vu depuis Genève. J'ignore la hauteur de cette chaîne, certainement plus basse que le Jura. Je la juge d'environ trois mille pieds: elle est à l'Est de Rome, et paroît depuis cette ville s'étendre du nord au sud.

" Le sècond point saillant dans le Latium, est le Mont-Albane, aujourd'hui *Monte-Cavo*, remarquable autrefois par le temple de Jupiter *Latialis* placé sur le sommet de la montagne à 2920 pieds au-dessus de la mer.

" Le Mont-Albane uni par sa base d'une côté à *l'Algidus* des anciens, et de l'autre au Mont-de-Velletri, forme une masse isolée, placée dans une grande plaine, presqu' à égale distance de la mer et des montagnes calcaires. Elle séparoit autrefois

kingdom of Naples. This district is every where bounded by the sea on one hand, and by the Appennines on the other; in the part of it belonging to Rome, and thence called the *Campagna di Roma*, there is (according to a work presented to *Pius the Sixth* on its cultivation) 112,909 *rubbie*, or 940 square miles, of 74 to a degree.

Two-fifths of this extensive tract is, according to this work, the property of the church, *i. e.* the convents and other religious communities; and the remaining three-fifths is the property of about 100 lay proprietors.

le pays des Latins de celui des Volsques et des Herniques. Une chaîne de collines couronne aujourd'hui le pied de cette grande montagne; elle a sur chaque élévation une petite ville qui par les charmes de son site semble destinée à être le centre d'un paradis. Frascati et Albane sont les points habités les plus rapprochés de Rome, dont ils ne sont éloignés que de quatre à cinq lieues. La grande plaine qu'il y a devant ces villes, et la montagne qui s'élève derrière elles, sont également inhabitées.

Le troisième point saillant dans le paysage est au Nord-Est de Rome, c'est le Soracté connu par Horace et Virgile, élevé de 2119 pieds, absolument isolé de la grande plaine; sa distance de Rome est d'environ huit lieues.

Après le *Soracté* le point le plus élevé en passant au Nord-Ouest, c'est *Villa Millini*, placée sur le sommet de *Monte-Mario*, à une demi-lieue de Rome, à 440 pieds au-dessus de la mer. Ce point, le plus bas, en le comparant aux montagnes dont nous avons parlé, est le plus saillant dans la grande plaine dont il occupe le centre. Il y domine sur les sept collines de Rome, et sur toutes les autres élévations, qui, comme de grandes vagues à larges bases, remplissent ce que nous n'appelons que par comparaison la *plaine*.

Ces quatre points cardinaux, qui dominent dans le Latium, sont de nature tout-à-fait différente. Les montagnes de la Sabine sont calcaires; Mont-

Albane, peut avoir un noyau calcaire, mais il est absolument recouvert d'éjections volcaniques, et *Rocca-di-Papa*, le rocher le plus élevé que j'y aie observé, est de *Peperino*. Je ne connois point la nature du *Soracté*, mais je le soupçonne couvert de produits volcaniques, puisque la plaine des environs en est couverte. Sa forme allongée en dos d'âne, feroit soupçonner que son noyau est calcaire, ou du moins non volcanique.

Villa-Millini est une roche coquillière peu dure, dont le pied est plongé dans le terrain volcanique. Avant de quitter l'encadrure de la plaine, je ferai quelques observations.

La grande plaine de Rome est entièrement *dénuée de pierres*. On y feroit cent milles sans en trouver une qui n'y ait été placée par les hommes, ou ne soit détachée de quelque roche volcanique très voisine. La ville de Rome, et tous les chemins antiques, sont pavés de lave dure. Ce n'est qu'en approchant des montagnes calcaires, surtout du côté de Palestrina, l'ancienne *Préneste*, que l'on commence à trouver des pierres calcaires parmi le sol volcanique. Il est probable que ce qui élève le sol du côtè de Préneste, ce sont les débris de ces roches calcaires, que l'on retrouve quelquefois à découvert sur la pente de la montagne. Cette plus grande élévation du terrain, causée par une base de débris calcaires pré-existante aux volcans, est cause de la fraîcheur du climat de Préneste, qu' Horace appelle *Frigidum*

Preneste, et qui l'est en effet, en comparaison du climat de Rome, et surtout de celui de la côte beaucoup plus basse d'Ostie et de Laurente.

Ce qui me fait croire que le Mont-Albane a un noyau calcaire, c'est sa forme allongée, sa grande élévation au-dessus de la plaine volcanique, et surtout sa ressemblance avec le *Monte-Circello* qui n'en est éloigné que de quelques lieues, et qui, mis à nud par la mer, se trouve être calcaire, mais recouvert par les volcans.

Si le Soracté auNord, l'Albane au Sud, et les montagnes de la Sabine à l'Est, étoient calcaires, on pourroit se permettre la conjecture que la base du sol volcanique de la campagne de Rome est aussi calcaire. J'ai vu dans quelques grottes, comme dans celle appellée *Del Mondo* sous *Tivoli,* des grosses pierres calcaires, enchassées dans les éjections volcaniques qui formoient la voûte de la caverne, ce qui prouve que les volcans ont travaillé sur des pierres de cette espéce.

Je n'ai aperçu aucun produit de montagnes primitives dans le Latium.

J'ai dit que *Villa-Millini* est un *grés* rempli de coquillages ; toutes les collines voisines de Villa-Millini, comme le Janicule, et celles qui sont au Nord-Ouest de Rome du côté de la mer, paroissent plus hautes que les autres élévations de la plaine. Cette plus grande hauteur ne proviendroit-elle pas de ce que ces collines reposent sur des bancs à coquillages, pareils à ceux que l'on

retrouve à Antium et à Nettuno au Sud, et à Magliano au Nord, qui çà et là sortent du terrain volcanique, comme à Villa-Millini, et peut-être communiquent entr'eux sous la plaine ?

Si l'on parvenoit à distinguer le sable volcanique par des caractères constans, on seroit en état de décider si les sables de ces bancs à coquillages plus on moins durcis, ne sont pas déja des produits de volcans antérieurs à ceux qui ont formé et recouvert le Latium.

Venons à la grande plaine des environs de Rome. Vue depuis quelques hauteurs, comme depuis Albane, cette vaste étendue entre la mer et les montagnes paroît assez unie, et cependant ne l'est point.

Le cours du Tibre, qui, avec les quarante-deux ruisseaux et rivières qui le composent, coule de l'Est à l'Ouest, prouve la pente général de la plaine vers la mer. Le terrain a la même pente sous le Mont-Albane, comme on peut s'en convaincre par la direction des rivières qui le traversent vers Astura et Ardée.

Outre la pente générale de la grande plaine de l'Est à l'Ouest, chaque portion de terrain a un mouvement ondulatoire particulier, qui forme des hauts et des bas, c'est-à-dire des vallons et des collines a pente très douce, partout où les eaux ou bien les hommes n'en ont pas enlevé la surface terreuse, jusqu'à entamer le noyau pierreux qui en compose la charpente. Les sept collines de

Rome sont sept ondulations de cette mer volcanique, mais nous ne voyons plus que les noyaux du Capitole et du mont Palatin.

J'ai vu sous Albane des crevasses de trente pieds de profondeur formées par les eaux, où le sol toute volcanique etoit parfaitement uniforme. C'étoit toujours une terre jaunâtre ou rouge différemment nuancée entre ces deux couleurs, composée d'argile mêlée de sable, sur-tout de beaucoup de debris de pierre-*ponce* et de petits fragmens de *schorl*. Cette terre est poreuse et légère lorsqu' elle n'est pas humectée, et la grande étendue du sol volcanique se trouve partout plus ou moins recouverte de *terre végétale noire, souvent profonde de plusieurs pieds.*

Les éjections volcaniques semblent avoir eu leur direction principale du Nord au Sud, puisque le Mont-Albane élevé de 2920 pieds en est entiérement recouvert, tandis qu'au Nord-Ouest de Rome, Villa-Millini qui n'est qu'à 440 pieds d'élévation ne paroît pas l'être entièrement, et qu'à l'Est, sur la pente des monts calcaires, le sol volcanique finit à 30 ou 40 toises au-dessus de la plaine.

Parallèlement à la mer, à une petite lieue de son rivage, s'éléve une suite de collines, qui s'etend depuis le Tibre jusqu'au-delà d'Ardée, du côté d'Antium. Ces collines encore volcaniques, sont le premiere rivage de la mer, et l'ancienne limite entre l'empire du feu et cela de l'eau.

Élevées de trois ou quatre cents pieds au-dessus du niveau des eaux, elles semblent être la coupe de la base volcanique qui supporte l'immense campagne de Rome, presque toute entière du domaine des volcans.

La langue de terre parfaitement unie et basse, qui s'etend entre ces collines et le rivage de la mer, est entièrement formée par les alluvions du Tibre et de la mer, qui reporte à la terre les sables de ce fleuve."

He observes in another part, "Le terrain volcanique de Rome a peu de rapports avec le sol des environs du Vésuve, composé de décombres et de laves posées les unes sur les autres et croisées en tout sens. La matière qui compose les élévations volcaniques de la campagne de Rome, est d'une plus grande uniformité que celle des pays où les volcans ont fait leur jeu dans un autre élément que l'eau. Dans le Latium c'est partout la même terre, formée par ce qu'on appelle à Naples les *Cendres du Vésuve*, ou bien ce sont de grandes coulées de laves, dures, brunes, partout uniformes, qui, probablement, occupent plusieurs lieues d'étendue. Il y en a à *Capo di Bove* à une demi-lieue de Rome; cette même lava se trouve à une grande lieue plus loin au delà de Ponté Buttero, et se retrouve encore d'un côté opposé, formant le cratère du petit lac Régille, à trois à quatre lieues à l'Est de *Capo di Bove*, et les cratères de Nemi et d'Albane à quatre et cinq lieues au Sud de

ce même lieu. Cette grande étendue de lave dure et compacte est partout recouverte de terre.

Les collines volcaniques qui forment les ondulations de la plaine ont toutes un noyau de pierre dure appellée *peperino* ou *tuffo*. Ce grès ou noyau volcanique ne paroit point d'une composition essentiellement différente de la terre qui l'enveloppe, il semble n'y avoir d'autre différence entr'eux que dans le degré de durcissement de ce composé, durcissement qui va en augmentant à mesure qu'on approche du Pépérino, qui n'est encore que cette même matière devenue assez compacte pour être employée dans les batimens."

" Une autre singularité de ces collines volcaniques est celle d'être percées dans tous les sens par des cavernes. Je puis affirmer que je n'ai pas vu un rocher sans les. Ces cavernes n'ont aucun rapport avec celles que j'ai vues dans les environs du Vésuve. L'on n'y voit jamais aucune trace de fusion, ce sont des voûtes presque toujours très séches percées dans une terre plus ou moins durcie. L'absence de toute trace de fusion, leur forme presque toujours ronde, perçant quelquefois cylindriquement les rochers, font soupçonner qu'elles sont l'ouvrage des eaux, peut-être mises en mouvement par le feu d'une manière tout à fait inconnue."

" Enfin, ce même sol caverneux a produit ces souterrains inextricables appellés *Catacombes*. L'on pourroit faire soixante milles dans ce labyrinthe

mystérieux, commencé par les volcans, et continué, peut-être, par ces sauvages du Latium."

" Pour achever le tableau du sol volcanique de la campagne de Rome, je dirai deux mots des nombreuses sources sulfureuses que l'on y rencontre en tant d'endroits. Il y en a plusieurs dans la moitié occidentale du Latium, qui sont blanchâtres, apres, et très acides au gout." " La plus abondante des sources souffrées est celle, entre Tivoli et Rome, que l'on voit s'engouffrer en partie dans la plaine."

" Au-delà de Magliano en montant vers Otricoli (qui est le commencement des Apennins,) le sol volcanique disparoit entiérement, et je ne crois pas que l'on en ait jamais trouvé aucune trace le long de l'Adriatique, tandis que la côte occidentale de l'Italie en fait voir très frequemment, jusques dans le golfe même de la *Spezia*."

Elsewhere he says, " Il y a moins d'eau, et probablement moins de marais, aujourd'hui dans la campagne pestilentielle de Rome, qu'il n'y en avoit dans le tems de sa plus grande population. Les marais Pontins, sont plus comblés aujourd'hui, qu'ils ne l'etoient alors, puisqu'au tems d'Homère, une partie de ces marais étoit couverte par la mer, qui faisoit une île de la montagne de Circé. Le marais d'Ostie étoit plus grand qu'il ne l'est aujourd'hui. Le lac d'Albe fut saigné pendant le siège de Veies, et Pline parle d'un lac placé sous Aricia, (dont nous voyons encore le

bassin,) qui paroît avoir disparu au tems de la république.

" Je ne vois qu'un changement essentiel arrivé à la campagne de Rome, qui ait pu influer sur l'air du pays, *c'est le dénuement absolu d'arbres,* dont cette terre tourmentée par tant de lois meurtrieres, est affligée maintenant. Les fievres putrides finissent assitôt que les pluies commencent. Cet indice, ce besoin d'humidité semble redemander à l'homme ses superbes végétaux, dont il a si indignement dépouillé cette terre jadis si feconde, et si dégradée aujourd'hui."

Such is a correct sketch of the topography of Latium, as given by this ingenious writer; which, from its accuracy, must have taken him considerable time and pains to collate; and which, except where they are intersected by branches of the Apennine chain, may be considered as applicable to the *Maremma,* or those extensive plains bordering the sea, from near *Piumbina,* opposite the island of Elba to *Calabria;* the volcanic region having taken a direction nearly north and south along this coast, and extending in a direct line to *Sicily,* which as well as this part of Italy appears to be indebted to the volcanoes for its great fertility.

A comparison between the former and the present state of the *population* and *agriculture* of the Campagna, will show the connexion which these have always borne, and still continue to

bear, with the salubrity and insalubrity of its air; and will point out the real source of its present state.

For this purpose I shall continue my extracts from the same work.

" Avant Romulus (say M. de Bonstetten) cinquante-trois peuplades occupoient ce Latium aujourd'hui si mal-sain et si désert, et les premières villes avec lesquelles Romulus fut en guerre, n'étoient pas à deux lieues de distance de quelqu'autre ville, cependant chacune pouvoit mettre une petite armée sur pied."

" Durant les six premiers siècles de Rome, les Romains vivoient tous à la campagne; et le petit peuple restoit toute l'année à la ville. Les habitans du Latium de ce tems là étoient, comme nous venons de le voir, fameux par la force de leur corps, et par *une santé*, que tous les auteurs, qui ecrivoient au tems de Rome corrompue, mettoient sans cesse en opposition avec celle des Romains énervés de leur tems."

" Il n'y a pas une place de la campagne de Rome, qui n'ait été habitée une fois, puisque dans les Marais Pontins même, il y avoit jadis vingt-trois villes. Il semble qu'on en peut inférer qu'il n'y a pas un lieu dans cette plaine empestée de Rome qui n'ait été salubre autrefois."

" Strabon dit: tout le Latium est fertile, excepté *quelque places près de la mer* où le sol est maréca-

geux, et mal-sain, comme par exemple dans le territoire d'Ardée."

" Varron assure que les Romains qui vivoient toute l'année à la campagne, jouissoient d'une meilleure santé que les habitans de la ville." (L. II.) " Ce ne fut pas sans raison que nos ancêtres donnèrent la préférence aux tribus de la campagne sur les tribus de la ville.—Ils avoient diviséleur temps de manière à être huit jours occupés aux travaux de leurs champs, et à faire au neuvième les affaires qu'ils avoient à la ville. Tant qu'ils restérent fidéles à ce genre de vie, il en résulta que les champs étoient de la plus grande fécondité, et qu'eux-mêmes jouissoient de la *plus parfaite santé*." Dans cette même *campagne* où l'on meurt ajourd'hui de la peste.

" Columelle parle de la force de corps des Romains, qui vivoient toute l'année dans les champs, c'est-à-dire dans la campagné de Rome. Il met ces laboureurs triomphateurs en opposition avec les Romains de son tems, tellement énervés par leurs vices, *que la mort*, dit-il, *trouve peu de chose à changer en eux ;*" tandis que les anciens Romains toujours occupés à la chasse, ou aux travaux de leurs champs, surpassoient à la guerre les habitans de la ville, et par la force du corps, et par l'habitude des travaux penibles."

" Palladius avertit de ne pas acheter une campagne dans le fond des vallées, parce que l'air en

est souvent mal-sain." N'est-ce pas dire, qu'il est sain partout ailleurs? Pline le jeune en parlant de son Laurentum, réputé mal-sain aujourd'hui, ne dit pas un mot du mauvais air. La preuve que l'air en étoit bon, quoique très près du Marais d'Ostie, c'est que la côte étoit garnie de maisons de campagne, habitées par les plus riches Romains qui, ayant à choisir dans les trois parties du monde, preferoient à tout l'univers connu, la campagne aujourd'hui empestée de Rome!

"Après la prise et la destruction de la ville de Rome par les Gaulois, dans la 365 année de Rome, les Tribuns du peuple firent la motion d'abandonner les mazures de leur patrie pour aller s'établir dans la belle ville de Vejes, conservée entière et toute à la merci du vainqueur. Camille, dans le discours qu'il fit pour detourner les Romains d'un projet si funeste, leur fait sentir tous les avantages de leur Ville-Mère, et dans l'enumération de ces avantages il parle de *l'air parfaitement sain*, des sept collines, aujourd'hui empestées, de Rome, qu'il appelle *saluberrimos colles*."

Were more proofs necessary, of the extent to which population grew in the *Campagna di Roma*, when in its *natural state;* that is, when its population was not the fruit of foreign conquest, but of its fertile soil and salubrious sky, it were easy to produce them; but these cited being conclusive on these points, a review of the causes which have led to so striking a change in both, as is unfortu-

nately but too apparent at present, is not only necessary to the object of this inquiry, but worthy of insertion for the moral it conveys. These causes are so identified with the history of its agriculture, that in its *flourishing condition,* is found *the cause* of its salubrity, and of the virtue and happiness of the people; as the reverse of all these have been the fruits of its *degradation.*

" Après l'expulsion des Rois, on assigna à chacun des citoyens sept arpens. Le terrain de la république s'accrut encore; mais la cupidité faisant des progrès bien blus rapides que les conquêtes, il fut défendu par la loi de *Licinius Stolo* d'en posséder plus de cinq cents, et l'auteur de la loi fut le premièr puni."

" Dans ces temps de la grande prospérité de l'agriculture, il y avoit aussi une grande abondance." " C'est qu'alors," dit Pline, " les généraux d'armée cultivoient leurs champs de leurs propres mains, *et la terre même sembloit sensible à la gloire des héros qui de leurs mains triomphales conduisoient eux-mêmes la charrue. Gaudente terra vomere laureato, et triumphali aratore.* Et ces grands personnages ne s'appliquoient pas moins à l'agriculture qu' à la guerre, et n'étoient pas moins attentifs à préparer un fonds qu'à bien placer un camp. Lorsque *Seranus* reçut la nouvelle de sa nomination au consulat, il étoit occupé à semer son champ. De là le nom de *Seranus le semeur. Quintus Cincinnatus* fut trouvé en pareille occasion,

labourant quatre arpens de terre qu'il possédoit au Mont Vatican, et qu'on appeloit dit Pline encore aujourd'hui les *près*, *prata*. On dit même qu'il avoit la tête nue, et le visage couvert de poussière, lorsque l'huissier du sénat vint lui annoncer qu'il étoit nommé Dictateur, de sorte qu'il fallut que l'huissier lui ordonnât de mettre sa robe pour recevoir les ordres du Sénat et du peuple Romain. Tels étoient les huissiers appellés *Viatores*, parce qu'ils alloient par les champs chercher les senateurs et les capitains pour les faire aller à la ville. *Aujourd'hui, l'agriculture est exercée par des esclaves, qui ont des marques au visage.*"

" Le rang et la dignité du citoyen se régloient suivant qu'il étoit laboureur ou non. Ainsi on tenoit pour *les premiers de Rome* ceux qui avoient des terres."

" Les Fabius, les Lentinus, les Cicerons furent appelés de la sorte à cause des différens *légumes* que leurs ancêtres cultivoient avec le plus de succés. Les *Junius* prirent le nom de *Bubulcus*, *bouviers*, à cause d'un de leurs ancêtres qui étoit un excellent bouvier."

Such are the accounts transmitted by their best historians, of the state of agriculture in Latium, and of the respect in which it was held by the ancient Romans, at a time when their virtues were laying the foundations of an empire which was destined one day to overshadow with its power the habitable globe, and when the domestic

and public virtues were in equal accordance, and had attained their greatest ascendency among them.

What a striking contrast does this picture of the Campagna and of its inhabitants present, to *the state of both* in our times! In this country, now, inhabitants scarcely exist; and the profession of agriculture is considered as a *species of infamy*. I recollect when I was resident at Rome, the *Duke de Laval-Montmorency*, the French ambassador, acquired some credit by saying, at one of his *soirées*, at which a whisper went round that the father of a lady, who happened to be one of his guests, *sold hay !*—" *Qu'il vaut mieux de vendre le foin, que le manger !*"—or, in other words, " 'Tis better to sell hay than be a *brute*." Here, such of the youth of the principal families as are not shut up in religious establishments, are seen dissipating life in some frivolous pursuit, when not occupied in analyzing the filthy details of low sensuality, with scarce a quality to redeem their ancient name.

This strikes one with the truth, that man is, in a great measure, the child of circumstances; and that governments may be considered, as far as regards the *mind*, what optical instruments are to the *vision*. In ancient Rome every thing announces the *colossal stamp* of the public mind; the infant Hercules is as apparent in the *Cloaca Maxima*, as in the famous *Emissarius* of the Alban

Lake. Her designs announce a scope of vision in which the littleness of *self* was altogether lost sight of;—outstripping the narrow limits of *time*, and assimilating with eternity!

" Les Romains (remarks Bonstetten) sont la seule nation, qui ait su réunir les mœurs d'un peuple agricole, à tous les avantages que leur donnoit une grande ville qui ne les corrompoit point encore. *Les Romains d'aujourd'hui sont en ceci précisément l'inverse de leurs ancêtres,* Malgré beaucoup d'esprit naturel, ils ont, dans leur nullité, perdu les moyens d'exister à la campagne, et n'ont conservé de la grande ville que la corruption et les préjugés." " A la prise de Carthage, le sénat Romain ne conserva parmi les bibliothèques trouvées dans cette ville malheureuse, que les vingt-huit livres de Magon sur l'agriculture. Or, voici la premiére phrase de ce livre si cher aux Romains d'alors. *Je n'ai rien à dire à ceux qui ne savent pas quitter la ville pour aller vivre dans leurs terres.*"

As this sketch of the former and present state of the Roman Campagnia would be imperfect without a review of the causes that have led to such fatal results, I shall give what I find on this head in the work above cited, which I consider as conclusive, and which shews the ignorance of those who would attach to the *Papal Government* the blame of this change.

" Si je faisois l'histoire de l'agriculture chez les habitans du Latium, je distinguerois quatre épo-

ques. Jusqu'au tems de la république Romaine les Latins étoient moins agricoles que pasteurs. Cela est si vrai que tous les premiers revenus de Rome naissante, provenoient de l'amodiation des pâturages de la ville; car, même aprés Romulus, et sous la république on donnoit le nom de *pâturage* (*pascua,*) à tous les revenus publics de quelque nature qu'ils fussent. Cette première époque, antérieure á l'invention de la monnoie battue, étoit le temps des mœurs douces et innocentes, et la continuation de ce siècle d'or, que les poëtes placent en Ausonie, sous le règne du bon Saturne, qui enseigna peut-être à couper le blé ou l'herbe, et á faire du foin pour les troupeaux. Cette époque comprend entr'autres les quatre siècles de la domination de la ville d'Albe, dignes, peut-être, d'appartenir encore à l'âge d'or, comme nous sommes autorisés à le présumer d'après l'ètat florissant du Latium au temps de Romulus.

" La seconde époque commence à-peu-près avec la monnoie, sous le roi Servius-Tullius. Elle se distingue par des guerres continuelles, par l'usage de la monnoie et de l'usure, mais plus encore par les mœurs simples de ces héros, à la fois, agricoles, législateurs et guerriers."

" Les Romains des quatre premiers siècles de la république sont de tous les peuples du monde celui qui a le mieux su allier les mœurs avec la puissance, et réunir la vie simple du laboureur et du guerrier avec les lumièrs de l'homme d'Etat. Sans

les guerres et les incursions de l'ennemi ses richesses l'eussent corrompu, et sans ses richesses toutes agricoles il n'eut pas su faire la guerre. Dans cette seconde époque l'Italie se suffisoit à elle-même, et l'agriculture avoit atteint son plus haut période."

" Les plus riches conquêtes des Romains se firent dans le siècle des Triumvirs, si funeste aux Romains mêmes. *Dès cette trosième époque l'agriculture disparut dans le Latium avec les mœurs, avec la médiocrité des fortunes, avec les hommes mêmes ; et les petites propriétés englouties dans les grandes terres, furent les premieres suites des proscriptions, et perdirent l'Italie.*"

" La campagne de Rome dévastée par les Triumvirs, dépouillée des mains honorables qui en faisoient valoir le sol, (le cultivateur avoit été égorgé dans les guerres civiles) n'eut bientôt plus que des palais, des jardins et des esclaves. Aux Cincinnatus, aux Fabrices et aux Catons, succédèrent des laboureurs esclaves ou malfaiteurs, qui sillonnoient la terre avec les fers aux pieds, et que chaque soir on renfermoit dans des prisons souterraines. Quel contraste de ces tems avec ceux où la terre se plaisoit, comme dit Pline, à se sentir l'objet des soins d'un héros cultivateur, conduisant lui-même une charrue couronnée de lauriers !"

" *Les largesses des Empereurs qui faisoient vivre le peuple de Rome dans l'oisiveté et les jeux du cirque, tenoient le prix du blé si bas, qu'on cessa*

peu-à-peu d'en cultiver dans le Latium. On se fit du pillage des autres nations un système réglé, un mode établi d'administration. Le beau sol de la campagne de Rome n'avoit plus d'autre prix que celui qu'on vouloit lui donner en y bâtissant des jardins et des palais; et c'est encore Pline qui nous apprend que le terrain, aux environs de Rome, étoit à vil prix."

"Qu'on se rappelle l'histoire; on verra succéder aux Lucullus et aux Crassus, aux Narcissus, et aux Pallas, les Aniciens; at aux Aniciens les Eglises et les Couvens; puis, enfin, le népotisme de la Rome papale; toujours de grands propriétaires qui succèdent à d' autres grands propriétaires."

"Ainsi le luxe des Romains, les largesses des Empereurs, les invasions des Barbares, puis les petites guerres du moyen âge, enfin le *népotisme*, empêchérent, durant prés de deux mille ans l'agriculture de renaître. Depuis César jusqu'à ces derniers temps, Rome, par la supériorité de ses armes temporelles, puis spirituelles, n'avoit point cessé de vivre aux dépens des autres nations, et plus elle avoit de ressources au dehors et moins elle en trouvoit en elle-même. Cette troisième époque est celle des grandes terres, que Pline appelle *Latifundia*, et qui perdirent, dit-il, l'Italie."

"La quatrième époque (he continues) a commencé à la dernière paix du Pape avec la république Françoise. Cette immortelle capitale du monde, dépouillée de ses meilleures provinces et

de ses meilleurs revenus, réduite désormais à ses propres ressources, est maintenant forcée de tirer parti des grandes richesses de son sol fertile, ou vivre avilie et condamnée à une immortalité d'autant plus honteuse, que le nom qu' elle porte est majestueux et ineffaçable dans les annales de l'Histoire."

From this history of the agriculture of Latium it will be seen, that as long as Rome depended on the resources of *her soil,—abundance, salubrity, and happiness,* crowned the industry of her citizens; and that the decay of her agriculture, and of her morals, had its source in her citizens placing their dependance *on exterior or foreign resources,* to the total neglect of those which nature had intended for them. With the neglect of her agriculture and the decline of her morals, she was sowing the seeds of a scourge which was one day to turn her fertile plain into an unproductive and pestilential desert. This seems a just retribution for slighting the benefits which a bountiful Providence had placed at their disposal! Of the extent of the evil inflicted by this scourge the following passage will convey some idea.

" Il y a une déesse Romain placée sur la tour du Capitole. Si cette statue avoit le sentiment de son état, quel eut été son supplice d'être condamnée depuis tant de siécles à voir les déserts qui entourent cette ville autrefois si superbe."

" La race humaine semble finir avec le capitole,

le désert commence dans la ville même de Rome; au delà du temple de Vesta, au delà du Forum; il n'y a presque plus que des èglises ruinées, des couvens abandonnés, des mazures, quelques magasins à foin, des jardins et des vignes solitaires. Sorti de la porte de St. Paul vous voyez quelques maisons abandonnées par leurs maîtres, à peine gardées par quelques spectres livides. Delà jusqu'à Ostie vous trouvez deux abris infects que l'on nomme hôtelleries. Vous avez vu Ostie. Le magnifique Port-Trajan est représenté par une ferme. Fiumicino est un petit village, puis à droite et à gauche le désert s'étend indéfiniment au Nord et au Sud. La maison de Castel-Fusano n'est habitée que pendant quelques semaines de l'année. A Torre-Paterno, il n 'y a que des pâtres sans famille. A une lieue delà, il y a une maison du Prince Borghese toujours inhabitée; à quelques lieues au delà vous trouvez à St. Lorenzo des Buffles avec quelques pâtres, puis encore le désert jusq'à Antium et Nettuno, deux villes, qui réunies, ont à peine la population d'un village Milanois; au delà, le désert reprend encore. Il n'y a dans les deux villes d'Ardée et de Pratica prises ensemble, guère plus de cent personnes réellement domiciliées toute l'année. Depuis là, jusqu' aux montagnes de la Sabine, dans un espace de trente à quarante milles, il n'y a que quelques maisons abandonnées, où des ouvriers affamés viennent dans le temps des moissons ou des

semailles, partager avec les hiboux des mazures sales et tombantes. Au delà du Tibre le désert recommence, et va jusqu'à l'ancienne Népété, et à l'Est jusqu'à la mer, quoique cette partie soit moins dévastée que la moitié méridionale.

" Il y a dans cette étendue de plus de cent lieues quarrées, moins de familles que de maisons, et moins de cuisines que de familles; car la plupart de ces habitans solitaires ne vivent que de pain apporté de Rome, et d'herbes crues.

" Quelques-unes des cinquante-trois nations qui existoient jadis dans le Latium, sont représentées par *une seule maison.*

" La grande Ville de *Gabii* n'est plus que la demeure d'un troupeau de vaches. *Fidene,* où tant de milliers d'hommes périrent par la chûte d'un amphithéâtre, est la mazure d'un étable de moutons, et *Cures,* l'illustre patrie de Numa, une hotellerie; *Antemné* avec ses tours superbes, *Collatia, Cenina, Veie, Crustumenium* et tant d'autres villes, qui prouvent l'état florissant du Latium, furent englouties en peu d'années par Rome naissante, déjà instruite à dévaster la terre; et l'on cherche encore le lieu où elles ont existé.

" Ce n'est pas que le gouvernement de Rome, soit moins animé de l'amour du bien public qu'aucun autre gouvernement de l'Europe; mais mille raisons l'empêchent d'aller en avant avec les lumières. *La force de ce gouvernement reposant sur d'antiques opinions,* l'immobilité semble faire partie

de sa dignité même. Le repos éternel dont il jouit, puisqu'il vit sans moyens de défense, l'âge et la majesté de son chef et de son sénat, n'en font plus qu'une représentation imposante. Mais toutes ces raisons de nullité disparoitroîent à la première volonté qu'il auroit d'être quelque chose; *car cet état porte en lui-même tous les élémens de prospérité.* On peut lui dire ce que Jésus dit au paralytique: *leve-toi, prends ton lit et marche.*"

Such are the portraits of the former and the present state of this celebrated district, sketched with a truth and feeling, which nothing but the lively interest its classic recollections inspired, could have enabled its author to depict with such force of colouring; exhibiting the most melancholy instance on record of the desolating effects of miasmata.

In it we behold the instance of a region in whose favour nature seems to have made an exception in her general laws; combining with the peculiar advantages of its situation, and fertility of its soil, the opposite advantages of the frigid and tropical skies, that would seem irreconcilable with each other.

> " Whatever fruits in different climes are found,
> That proudly rise, or humbly court the ground;
> Whatever blooms in torrid tracts appear,
> Whose bright succession decks the varied year;
> Whatever sweets salute the northern sky,
> With vernal flow'rs that blossom but to die;
> These, here disporting, own the kindred soil,
> Nor ask luxuriance from the planter's toil,

While sea-born gales their gelid wings expand,
To winnow fragrance round this smiling land!"

But lost are all these advantages to the *Campagna* in the present day; for Nature, as if indignant at the slight attached to her favours by those for whose benefit they were designed, has swept from it a race that seemed unworthy her further regard; thus restoring to their aboriginal inhabitants, the wolf, the fox, the wild hog, and entire *troupeau sauvage*, fields that inspired the muse of a *Virgil* and a *Horace;* and that proved an adequate solace for lives passed in the service of their country, to an *Africanus*, a *Pliny*, and a host of patriots and heroes besides.

Having thus shown the effects of Miasmata, a few brief extracts explanatory of the present state of knowledge respecting them, in the instance before us, may not be amiss.

"Il y a dans les pays du Midi (says Bonstetten) une cause de dépopulation, qui n'est pas connue dans les pays du Nord; c'est la corruption de l'air, qui *semble augmenter avec la dépopulation,* et former par lá une cause accélératrice de mortalité.

"Il y a dans chaque pays quelqu'explication favorite des phénomènes les plus frappans, à laquelle on a foi, et qui semble retarder toute recherche ultérieure sur la cause de ces phénomènes. Le mauvais air de Rome provient, dit-on,

des Marais Pontins: cela dit, on semble cesser toutes recherches ultérieures sur un fait de la plus grande importance pour l'humanité.

" Le mauvais air de Rome, connu sous le nom de *cattiva aria, est un phénomène encore peu connu*, quoiqu'on en parle depuis plus de deux mille ans," *&c.*

It is the custom with the writers on Italy to record their ideas on so prominent a subject in its modern history as is its *mal'aria;* and *Mr. Forsyth*, in his excellent work, has noticed it in the following manner:—

" This *malaria* is an evil more active than the Romans, and continues to increase in spite of all the science which they publish against it.

" Last autumn (1801, I believe,) four thousand persons died victims to it in the Roman hospitals. It is a battle renewed every spring and lost every fall.

" In some tracts the malaria has been established for many ages, but now it is advancing on the suburbs, and the city of Rome, while the checks opposed to its progress are either defective or absurd.

" By clearing the woods of *Nettuno,* which the ancients wisely held sacred, government has lately removed one defence against the *sea-vapours,* which now mixing freely with those of the land, render them doubly noxious.

" The mephitic air being heavy, and therefore

low, may be stopped by low hills, woods, and even buildings."

Elsewhere, he says, "Thus the Campagna remains the same melancholy waste, divided only by ruined aqueducts, without habitation, or hedge, or tree; and all this in spite of doctors who are daily offering new recipes to cure the air. Some prescribe the planting of olive or mulberry-trees, at once to absord the miasmata and enrich the country. One Cardinal has recommended a nightly patrol of the sheep and black cattle; another has proposed to *pave* the *Agro Romano. But whoever would project here a distant benefit to humanity against the present interests of great men, deserves to be sent, with the two Cardinals, to the academy of Lagoda.*"

Much more might be added in this way, were it necessary, but all equally vague as to the nature or cure of the evil.

Such is the extent (as it would appear) to which former inquiries into the nature of an evil of such magnitude as is that of the Miasmata has been able to penetrate.

As the *cause* and *manner* of their production have been discussed in the conclusion of the preceding part, it only remains at present to point out the means most proper to be applied in order to their extinction in such soils as originate them.

In the view before taken of Miasmata, it is shown that this evil does not exclusively originate in *marshes*, but that the more fertile class of what

are called *vegetable soils*, when exposed to a high temperature and not sufficiently cultivated, likewise originate miasmata, and those of a most deleterious kind.

The treatment I would recommend to both, in order to correct in them this tendency, is, however, nearly the same; with this difference, that in marshes, or where water lies stagnant in a soil, it is necessary, in the first place, to remove it by draining, so as to make it fit for practical agriculture; or where the *falls will not admit of this*, by *raising the surface*, so as that the humidity may be placed *sufficiently low*, not to be affected *by the temperature of the atmosphere*.

A successful operation of this kind was, I understand, executed a few years ago, on a tongue of land which divides the *Rhone* and *Soane*, between the city of Lyons and the confluence of those rivers about half a league below it; and which, by reason of the approximate level of their beds to it, would not admit of draining. This land, consequently, could not be cured by drainage of the miasmata which it annually occasioned, and which were the cause of considerable mortality in the city. This difficulty was obviated by *raising the surface* with rubbish collected in the neighbourhood.

When, by these means, such soils are made applicable to agricultural purposes, the next object is to *reduce in them the excess of vegetable matter*, which will be most speedily effected by *paring*

and *burning* their surfaces; and, in addition to the *increased absorbency* they will acquire, by mixing the *ashes* produced by this operation with the soil; *lime* should be added, if possible, so as to increase this absorbent power in them to the utmost, for *on this principle* of increased absorbency their improved salubrity must *chiefly depend. Active cultivation* must necessarily accompany these beginnings, which, of itself, is found to make soils *more absorbent* than the addition of any hitherto discovered substance can produce. It has been found by experiment, that *garden-moula* possesses higher absorbent powers than any other known substance, as the following table of experiments made by Professor Leslie, exhibits.

Alumine, causes a dryness of	84 degrees.
Carbonate of Magnesia	75
Carbonate of Lime	70
Silica	40
Carbonate of Barytes	32
Carbonate of Strontites	23
Pipe-clay	85
Greenstone, or Trap in Powder	80
Shelly Sea-Sand	70
Clay indurated by torrefaction	35
Clay strongly ignited	8
Green Stone ignited	23
Quartz ignited	19
Decomposed Green Stone	86
Green Stone resolved into Soil	92
Garden Mould	95

Thus proving the important facts, *that absor-*

bency in soils is a chief source of their fertility, and that *the more a soil is pulverized by labour, the greater is its absorbent power.*

As *auxiliaries* to the means pointed out above, for curing soils of miasmata, the most powerful are,—*planting them with forest or fruit trees,* by *the shade of which* the standard of their summer temperature may be *materially lowered;* and *irrigation,* where practicable, which, by sustaining *vegetation,* and checking a tendency to fermentation, when exposed to a high temperature, effectually extinguishes miasmata.

The efficacy of this latter is annually proved in the Roman *Campagna;* as after the fall of the first heavy rains in September, miasmata disappears.

The following is in substance the plan for the improvement of the *Campagna,* alluded to at the beginning of the present part, founded on the principles laid down in this inquiry.

Substance of a Plan for removing the Insalubrity of the Campagna di Roma, *presented by the Author, when at Rome, to the Marquess of Hastings, in* 1824.

THE insalubrity of the *Maremma* of Italy, of which the *Campagna di Roma* is a part, being chiefly the effect of ages of neglect and bad management on the part of the proprietors of its soil; and the evil having gradually increased to its present extent, individual exertion to bring about a permanent change in such an extent of country would, from its disproportion, go for nothing. In order to effect a change, *time*, *system*, and *combined exertion* are necessary.

While *Cincinnatus* and his compatriots esteemed the exercise of agricultural pursuits *as honourable*, Rome had not to complain of *malaria;* and if the Roman Government were desirous to avail itself of the natural resources of this part of its territory, and to change its solitudes of pestilence and death, into the wholesome residence of a numerous and happy population, it should begin by raising agriculture to the dignified station it once held in the estimation of the Romans.

For this purpose a society should be formed, composed of the principal proprietors of the Campagna, with the reigning sovereign at its head,

which with more propriety than that of the *United States* of America, might take the title of the *Cincinnati Society*, and whose object should be the encouragement of agriculture, and watching over its interests.

This first step taken, the Campagna commencing at *Terracina*, and stretching thence to the frontiers of Tuscany, in its extent from the mountains (the *Apennines*) to the sea, should be divided into *narrow sections*, which, according to the means that could be found for the purpose, should each year have a tenth or *twentieth* part of them ploughed up in their *entire lengths*. This could be done in the winter and spring months. In the beginning of summer the *sod* or turf thus detached, when sufficiently dry, should be collected into small heaps on the soil from whence it was cut, and at the commencement of the season of *malaria*, which is usually about the beginning of July, a proportion of these, on each section thus prepared, should be set on fire; dividing them so as that the entire might be consumed by the middle of September, at which season usually fall the heavy rains, which by extinguishing the fermentation of the soil, puts an end to malaria for the season. Thus by the operation of these numerous fires over its surface, on the atmosphere, and of the smoke generated by them, its insalubrity would in a great measure be removed; and the land thus treated, could by the end of the season be sown

with wheat and other crops, for which it would prove an excellent preparation, and after producing one crop, these sections might be let run to grass. Every succeeding year a proportion of the intermediate sections should be brought into cultivation in the same manner, until the whole of the surface underwent this operation, by which time the cultivators perceiving the good effects produced by the adoption of such a system, and becoming gradually more enlightened in agricultural pursuits, would, by giving them an interest in their prosecution, require no further stimulus to excite their industry; and in the first instance, by confining the entire agriculture of the Campagna to the sections thus annually broken up, but little more exertion would be necessary than that at present used.

The adoption of such a plan would be attended with the double advantage of restoring, in some measure, from its commencement, *salubrity* and plenty to the Campagna, and of awaking such a spirit of industry in the mass of the people as would be the best guarantee for the permanence of both.

In addition to this, measures should be taken as soon as they underwent the operation of burning, to plant the sections with forest-trees, in the manner that is observable in the *Campania Felix*, extending from Naples to *Caserta* and round *Vesuvius*. These trees being disposed in regular rows, at a

convenient distance from each other, answer the double purpose of screening the soil from the sun, and of propping the vines, which are trained in festoons from one to the other; thus forming a canopy of verdure extending over that immense and delightful plain. To this circumstance, to the continual cultivation in which the land is kept, and to the clouds of *ashes,* which the volcano throws over it from time to time, it owes its salubrity. The ashes, together with increasing its fertility, communicate to it *an absorbency* which naturally it does not possess, it being like the plain of *Pæstum* and the *Campagna di Roma,* a rich alluvial soil, exposed to the same temperature, and lying equally low with them; but being from these circumstances (partly the effect of chance) not only salubrious, but one of the finest and most fertile regions in the world, and furnishing a sufficient illustration of the practicability and efficacy of the plan here suggested.

In such parts of the Campagna as, from their marshy state, could not be turned to agricultural purposes, particular attention should be paid to preserving the *natural woods* from being cut down in the irregular manner they are at present; and to planting any part of such as are without trees, as by such means these districts (even in what are called the Pomptine marshes) being very few, and limited as to extent where they are, would not only be prevented from being *malsain* to any

great degree, but the little of miasmata they might engender, would be confined to their own limits by the foliage of the trees.

These marshes would also be admirably adapted for cultivating the *Arundo donax* or large reed, so common in the Campagna, which growing to the height of from nine to twelve feet, would not only afford the necessary protection to the soil, but from the variety of uses to which it is applied would amply remunerate the proprietors for the expense of planting. To these resources for the prevention of malaria, might be added a general system of irrigation, such as is practised in the great plain of Lombardy, and other districts of Italy, by dividing the streams that issue from the Apennines at appropriate elevations, and afterwards subdividing them in canals over the plain beneath, as far as the nature of the ground would permit.

Thus, without even the application of *Lime*, which it might be difficult to procure in sufficient quantity, the great and beneficial change necessary might be effected, without any expense to the Roman Government, as it would only have to appoint competent persons to see that each proprietor caused to be executed that proportion in the general arrangement which should fall to his share.

Should a change ever be effected in the *Campagna*, it needs not the spirit of prophecy to predict that it must be by the adoption of some such plan as the foregoing; and in the present enlightened state of the world, together with the straitened limits to which the loss of nearly the whole of her *exterior resources* has reduced the finances of Rome, common policy, let it be hoped, will cause her government to awake to her interests, and draw from her soil part of those resources which it is so amply competent to yield; laying aside that mental panacea for all sores which she uses in justification of her apathy, *that the malaria is the will of God* *.

* Literally the reply *Cardinal della Somaglia* gave to me, in a conference I had with him on the subject before I left Rome.

Note.—The Pomptine Marshes, that form so prominent a part of the Campagna, have been ascertained, by a late survey, to contain 138 Roman square miles, eighty rubie, and a fraction; according to Pliny they contained formerly thirty-three cities. Appius Claudius was the first, and Braschi (Pius the Sixth) the last, that undertook todrain them. Rappini was the engineer of Pius the Sixth in this work, the execution of which is said to have been attended with a great mortality among the persons employed in it. It was by Pius the Sixth the *Linea Pia* was projected and executed.

THIRD PART.

THIRD PART.

Classification and Nature of Soils. Principles of Agricultural Science. Present state of Agriculture in Italy, &c.

It is a curious fact, that though agriculture is the *first science* necessary to man in a civilized state, and the last with which he can dispense, the principles of it, and the influence it exercises on the atmosphere, are, perhaps, less understood than those of any other.

The effluvia that occasion Miasmata, having their origin in particular *soils*, it will not be irrelevant to the object of this work, to take a short but general review of them.

Soils compose the first, or exterior strata of the habitable parts of the earth. They are usually formed from the decay of vegetable and animal substances, mixed with earthy particles, and appear to possess in common, though in a very limited degree, and infinitely diversified by situation and the nature of their sub-soils, *a vegetative principle* in themselves. The most remarkable for this property are *Peat Moors*, and the *alluvial class*,

of which the former are but a species. These being intended by nature as the *matrice* or womb of vegetation, are placed, as it were, *suspended* between the sub-soils on which they rest, and the atmosphere. Thus necessarily exposed to, and partaking of the vicissitudes of the latter, they are subject to the action of both; and, consequently, are never long stationary in the proportion of their humidity and nutritive juices, but, like the *tides*, continually on the wane or increase of these.

Sub-soils are the stratas of primitive earth, on which soils rest, the peculiar qualities of which materially affect the formation and nature of the latter.

Soils are in general *fertile*, or *otherwise*, in proportion to the *retentive* or *absorbent* qualities of their respective sub-soils; as *soils* will not *form or grow on sub-soils*, which are absorbent beyond a certain degree. Consequently, sub-soils that are *most absorbent*, have soils *the least productive;* but these soils, from the small proportion of decomposable matter they contain, conduce most to a *wholesome atmosphere.*

Retentive sub-soils, provided *their* property of retaining *be not in excess*, are those whose soils are most fertile in vegetable produce, but necessarily tend *most* to originate *Miasmata*, or insalubrity in the atmosphere. This position involves a seeming anomaly, as relates to *the true principle of fertility in soils;* they appearing to be indued *with this*

quality, in proportion to the *extent of the absorbent powers they possess, contrasted with the absence of this principle in their sub-soils.* Such, however, appears to be the fact, and this leads to some curious and important conclusions in *the theory of vegetation;* for it would follow that plants in a state of vegetation have a capacity of imbibing, perhaps, a moiety of their sustenance from the atmosphere; and this capacity they appear to exert most powerfully in such soils as, *without losing their retentive power*, superadd to it, in the highest degree, *the property of absorption.* This, necessarily, includes that important branch of agricultural science, *the theory of manures:* for, if the combination of these opposite qualities in the soil, and its sub-soil, be essential to the formation of *a standard* by which vegetable soils may be judged; the deficiencies of particular soils may, with the greater facility, be pointed out; and the manures necessary for supplying these deficiencies be applied with the greater certainty.

On this principle we can easily explain why it is that *volcanic soils* are so eminently fertile, from the absorbent powers they possess; and on the same principle, why *lime, ashes, burned clay*, or any substance that has been exposed to the action of fire, becomes so powerful as a manure, when applied to alluvial soils, by imparting to them this absorbent power.

Hence it follows, that in their natural tendency,

fertility in soils is opposed to salubrity of atmosphere, and that this opposition is more perceptible in proportion as the fertilizing principle is more vigorously excited; which, with some exceptions occasioned by localities, is determined in its degree by the distances of places from, or their vicinity to, the equator.

Thus soils, or, with more propriety, *sub-soils*, so far as they regard the purposes of *health*, naturally divide themselves into two classes, *viz.*, the *retentive* and *absorvent.*

The latter class, in the several modifications of this principle, constitute the great majority of the soils of the earth, and by its continual operation in freeing the surface or vegetable stratas, from the redundance of the humidity, and of the fat alluvial matter which the decay of vegetable substances deposit in them, has the effect, generally, of preserving them in such a state, that even when exposed to high temperatures, there being but little noxious matter for heat to act on, their atmospheres remain pure and salubrious.

The other, or *alluvial class*, comprise the *flats* lying on the banks of rivers, of lakes, and in some districts along the sea-coast. These (from being occasionally inundated, and either from the retentive nature of their sub-soils, or the approximation of their surfaces to those of the waters in their vicinity,) being for the greater part of the vear saturated with moisture, and possessing no

means of discharging it, or the deposites left on them by inundations, and the decay of vegetable substances that spring from them; which combining with the vegetative principle inherent in them, thus continually augment in *the amount of their alluvial deposites,* which held (by their continual humidity) in a *species of solution,* they necessarily retain in them *the elements of fermentation;* from the action of which they appear to derive the vegetative principle alluded to, and when in *this state* (occasioned by a continued exposure to a high excitement) *originate Miasmata.*

PRINCIPLES OF AGRICULTURAL SCIENCE.

Agriculture, being so far connected with the foregoing inquiry, that it is chiefly by its application the evils of Miasmata proceeding from alluvial or other soils are proposed to be removed, I shall, as a necessary appendage, take a summary view of the principles of agricultural science.

In agriculture, and in other sciences, there are certain ideal points, which, though perhaps never attained to, yet the nearer they can be approached, impart the more perfection to those sciences; and even the attempting to arrive at which is seldom unrequited. Thus it is to the supposed possibility of the transmutation of metals that chemistry is indebted for many of her early and valuable dis-

coveries; as it is to the attempt of finding out the longitude that navigation owes much of its present state of improvement, *&c. &c.*

The object of agriculture is to assist or improve nature in the quality and quantity of the numerous products, animal, as well as vegetable, which man has found it his interest to cultivate; and which, owing to their number and the great variety found in their constitution, frequently require, to such a degree, seemingly opposite principles, to bring them to perfection, that, as St. Pierre, with some justice conjectures, there is not, perhaps, a square league on the surface of the earth, but is more peculiarly adapted, either in soil, in temperature, or both, to the production of some one species of product, than any other*.

To this great diversity of constitution in the products of nature, as well as in soils, and in temperatures, in different countries, it is, that agricultural science owes its birth; its object, as before mentioned being, to supply by art the deficiencies of nature, and thus approximate, as

* His words are "For my own part, if I might be permitted to hazard a conjecture, respecting the number of distinct species of plants, spread over the earth, such is my idea of the immensity of Nature, and her subdivisions, that I am disposed to believe *there is not a square league of earth but what presents some one plant peculiar to itself, or at least, which thrives there better, and appears more beautiful, than in any other part of the world.*"—First Study of Nature.

much as possible, her extremes, as occasion may require.

Though much has been done to attain this object, yet where nature is not aiding, *art* has its limits, beyond which it cannot go. And yet Providence has so ordained it, that by a happy conformity of constitution, those of nature's products most essential to man, are found to adapt themselves to almost every variety of soil and of temperature. This observation equally applies to the animal as to the vegetable kingdom, with this difference, that whatever animals lose by location in one quality, is usually compensated for by a superiority in some other.

If, however, any country be more particularly favoured than another in soil and climate; where the rigours of a Polar sky are found harmonized with the lucid firmament and genial glow of that of the tropics; where the vegetable products that luxuriate under both are seen blended and equally flourishing as in their parent climes; and where the domestic animals, though but little attended to, are, with the exception of their *Lord**, never found to degenerate—that country is Italy.

Thus divided by her barriers from the rest of Europe, Providence, in making such important exceptions in her favour, would seem to have designed, by thus laying the foundations, to make her, as it were, the seminary of the universe.

* "*Man* seems the only growth that dwindles here."

But where nature is most prodigal of her gifts, unless industry and system be called in to employ and give them direction, they become worse than nugatory by the evils they occasion, as is exemplified in the present instance.

This *system*, by which the operations of husbandry are directed, is the science of agriculture, and it leads to an examination of not only Italian husbandry, but involves that of the principles on which it is, or should be, founded everywhere; as such principles not only apply to Italy, but to every other country where agriculture is practised.

Perfection in agriculture supposes that every part of the land of a farm has its use; and that its fields or divisions may be so arranged, as that *every year* they may not only be cropped, but that the entire may yield such a quantity of manure, as would by its application preserve the lands from degenerating by the continual produce they are made to yield; and thus prevent *the re-action* which active cultivation, when unaided by judgment, will occasion in the best soils; and likewise that by the complete cultivation of the entire, any one of its divisions may not be a drawback on the profits of another.

But as the size and divisions of a farm should be regulated by the capital of the proprietor, and by its fitness for particular products; which latter in farms, will be more or less numerous, as

locality and climate may suit them; it follows, that as systems in agriculture must be regulated *by local circumstances,* nothing can be laid down in this way for general adoption.

Therefore, it is, according to the number and value of the crops that any farm is capable of producing, that the system proper for it should be regulated.

From the circumstance of the different degrees of *nutriment* required by different crops, it is, that what is called *the succession of these* in the same piece of land from a single manuring is determined. This necessarily should govern the agriculturist in the division of his farm, in such a way, that every year one of its divisions should be renewed by the manure collected from the produce of the entire; that such manuring might suffice for the succession of crops contemplated, while the other divisions received in turn a similar renewal; and that the general economy of the whole might move on steadily, like a well regulated piece of machinery, without check or interruption in its course, and without having any considerable accession of labour or expense incurred by the general business of one year over that of another. But here again the circumstances connected with *locality* will interfere; as it is in proportion to the capacity of a soil to *retain manure* that both the number and quality of its crops in this way can be determined.

However, as a person conversant in practical agriculture, I have no hesitation to say, that in the better kind of upland soils (having tolerably retentive sub-soils) a system might be introduced, by which *seven crops*, each of *good quality*, might be grown from the same soil by the application of *a single manuring*, viz., a green crop, one of wheat or barley, *broad cast*, with grass seeds, two crops of meadow, one of *trenched* wheat, one of barley, and one of oats; and that a sufficiency of manure (with the exception of *lime*, where the nature of the soil requires it) might be obtained every year, in a farm divided into seven equal divisions, and all yielding crops, to manure sufficiently *one of these divisions each year;* so as to keep up the succession of crops without interruption; and that instead of such soil deteriorating, it would rather improve in quality by the operation of such a system*.

This arrangement in the application of manure and succession of crops, is only calculated for the production of a single crop each year from the same soil, as where *winter crops* are made to suc-

* My object in submitting this plan is simply to point out *the beneficial effects of system*, and the necessity that exists in practical agriculture, of understanding the precise point in the circle of crops contemplated, wherein the *chief application* of manure will combine most advantages; as I do not pretend to say of the *latter* crops in this succession, though they may be good in their kind, that they can be expected to be equal in quality to what they would be, if *each* succeeded to a *green crop* that had been adequately manured.

ceed the summer harvest, additional manuring for such would necessarily be required.

So much on the principles of agricultural science appeared to me an appropriate introduction to the following summary review of Italian agriculture, in order to assist such of my readers as are not conversant in rural affairs, to form a more correct judgment of its present state in this highly-favoured region.

REVIEW OF ITALIAN HUSBANDRY.

The first circumstance observable in passing through the different States into which modern Italy is divided, is the strong coincidence that exists between its agriculture and the country itself; the one equally as the other abounding in the most striking contrasts.

Italian agriculture naturally divides itself into *two systems,* resulting chiefly from local circumstances. The first is that which appears to be congenial to its soil and climate, and may be denominated the *garden, or spade husbandry;* the other chiefly caused by the *malaria,* is the *fallow system,* or (as it is called) *Agro Romano.*

The latter being that practised in the *Campagna di Roma,* and the greater part of the *maremma* from Leghorn to Calabria, is thus described by M. de Bonstetten—" Les champs sont ensemencés chaque troisième année. Ils sont une année en

jachére, une année en labour et une année à produire. On les laboure six fois; le premier labour s'appelle *rupitura*, le second *reconditura*, il doit être d'un pied et demi de profondeur, le troisiéme *refenitura*, le quatrième *rinquartatura*, le cinquième *rifrescatura*, sixième *sematura*. Ces différens labours doivent être faits dans toutes les directions."

By this system, as here described, three years and six ploughings are considered as necessary for the production of a single crop, and that too, be it recollected, in one of the most fertile soils and finest climates under heaven. In proof of this, the following anecdote taken from M. de Bonstetten's work will be considered as conclusive—

" Un jeune paysan de *Pratica* me dit: qu'il tenoit à ferme une *rubbia* du meilleur terrain, qui à la derniére récolt, lui avoit rendu *vingt et cinq rubbie de froment*. Comme le terrain en est trés bon, il n'y avoit semé qu' une rubba*."

Here is recorded a produce of twenty-five for one, a thing perhaps not to be equalled, except in part of Sicily, where it is reported to have sometimes amounted to *thirty*.

In the *Siennese* territory (according to Mr. Forsyth) it is usually from *eight* to *nine;* whilst in that of Florence it is not more than *five*.

This applies solely to *wheat*, which is the usual

* The *rubbia* of wheat is 640lbs. of 12oz. or 34st. 4lb. of our weight. The rubbia of land contains 4866 square toises or fathoms of six feet.

crop cultivated in the *Campagna di Roma*, in the neighbourhood of Leghorn and Pisa, *&c.*, but in part of the Pomptine marshes *Maize* is added, which grows there in the greatest luxuriance, as it does in the vicinity of *Naples*, and in the great plain of *Pæstum*.

The raised ridge of about five feet wide, is that in general use for the growth of wheat throughout these districts, as with us. The chief reason for this is, to rid the crop from a redundance of moisture, which otherwise it would be liable to, from the retentive nature of the soil. Nothing can exceed the luxuriance of the crop, particularly in the spring, its deep verdure proving the great strength and fertility of the soil. In the neighbourhood of Pisa (where the garden culture is blended with the Agro Romano, the fields being divided by poplar rows, to which the vines are trained) this is more particularly the case.

Pasturage is the never-failing consequence of this system; but instead of laying down or sowing the lands with artificial grasses, they trust to the kindly hand of nature for clothing them in her own way.

The garden husbandry of Italy is that from which the cultivator derives a proportion of the profits of his farm, from the *fruit* it yields him, including, of course, the produce of his vines. This system, from the multiplied business and care it requires, pre-supposes a numerous population, and a con-

sequent diminution in the size of farms, where it is in activity.

This system of husbandry is in great perfection in the *Val d'arno*, from near Pisa to Florence; the whole district having the appearance of a copse wood, from the intersections of the innumerable rows of poplar, mulberry, and other trees, which divide, and enclose in right lines, the numerous farms, answering the double purpose of yielding, by their *leaves*, food for the cattle (where pasturage is scarce), and the silk-worm, and serving as props to the vine, whose pliant branches are seen extended from one to the other in graceful festoons, connecting and embellishing this extended labyrinth of vegetation.

Most of these small farms being provided with a handsome cottage, peeping through the embowering foliage, throws over the whole of this fairy region, whatever poets have feigned of Arcadia. It is right to remark that the cultivation of the vine in Italy seldom interferes with that of other crops, the stem being allowed to grow to a certain height, so that the crops beneath have the same liberty as though the vines did not exist; as the *shade* of these latter, as well as that of the trees which support them, instead of being injurious to the former, may, even on the contrary, during the heats of summer, prove advantageous to them in such a climate as that of Italy.

The advantages of the *trench system* are so well

understood in this district, that the occupying farmer is usually obliged, by his contract, to dig up, or trench, one-third of his farm each year. By this husbandry *two crops a year* are usually obtained, *viz.*, wheat and a green crop. But this succession is interrupted occasionally by the growth of maize; this crop taking till the middle of September to ripen, while the wheat is usually cut down in the beginning of June. The soil of this part of Tuscany is for the most part a light porous earth, on which irrigation is practised throughout, by a series of small canals, the ramifications of which extend to every part of this region.

The next district, as we advance southwards, where this system is in general operation, is the celebrated one composing the vicinity of Naples, which is as remarkable for fertility, and the variety and abundance of its productions, as for those natural beauties that have furnished a theme for so many pens.

In addition to the crops common to the other parts of Italy, *cotton* of excellent quality is produced in the plane that lies between the base of *Vesuvius* and *Castell' a Mare.* The greatest attention is paid to the irrigation of this crop; which is effected by means of numerous wells sunk at short distances from each other through the plantations: where, from the approximation of the surface of

this plane to that of the neighbouring sea, water is everywhere found at a moderate depth.

Of this region, the most delightful as well as productive is, perhaps, that lying between *Castell' a Mare* and *Salerno*, than which, independent of its great fertility, nothing can be more romantically picturesque. This particularly is the case from the vicinity of *Nocera* to *Cava*, where the lofty mountains of *Torre di Chiunzo*, and of *Albino*, surmount with their bleak and rugged outline of castellated cliffs, the paradise that smiles beneath, well worthy of being, as reported, the *studio* of a *Salvator Rosa*.

The landscapes here, in boldness and richness of contrast between sublimity and beauty, are, perhaps, the most *eminently Italian* that are to be seen in the entire of this fascinating country. The valley for some miles exhibits the appearance of a town, composed of elegant country seats, interspersed with convents and churches, surmounted by their pointed *Campenili*, embosomed in vineyards and orchards, crowned by the sprightly green of the chestnut woods, forming the upper link in the ascending chain of vegetation, which so finely sets off their perspective.

The third, and by far the most extensive district of Italy, where the garden husbandry is practised with the greatest skill and success, is that on the Adriatic side of the *Apennines*, in-

cluding, with some few exceptions, the entire of the *March of Ancona*, the Bolognes, Milanese, and Venetian territory.

After quitting the dreary deserts of the *Campagna*, and the steep defiles of the Apennine, in the route from Rome to Ancona, the relief which the mind of the traveller receives from the suddenness of the contrast in approaching *Macerata* is difficult to be described. Here a people are met with who appear worthy of the soil and climate, from the great industry and taste observable throughout their territory—almost every perch of land in cultivation; the fields enclosed with thorn-hedges kept in the neatest order. Here we see the olive, the fig, and the vine, mingling their verdure with that of the wheat and other crops growing beneath; roads kept in the most perfect repair, on which the carters are encountered, clad in white cotton frocks and tasseled caps of the same substance and colour; the whole peasantry cheerful and intent on their affairs; every thing turned to account. In short, English habits and industry are beheld improving the advantages of an Italian climate, and heightening the natural beauties of an Italian landscape.

These observations do not apply exclusively to the vicinity of Macerata, of Loretto, and the greater part of the March of Ancona, but in general to the districts enumerated above, where this

species of husbandry is brought to the greatest possible perfection. Who has seen and can readily forget the banks of the *Brenta*, from near Venice to Padua, where the genius of *Paladio* presiding over the architecture only harmonizes with the beauty of the scene, without banishing the rural deities from the soil!—Who the vicinity of *Vicenza*, whose vegetable riches caused it to be called the *garden* of Venice; who the Alpine-skirted plains of *Brescia* and *Bergamo*, with their hundred crystal streams, or the delightful environs of Milan!

Maize and hemp are much cultivated in these districts; and artificial ponds for macerating the latter (usually divided into compartments by strong paling) are frequent. They use a novel manure for this crop (hemp), to which, I was told, they are very partial; *viz.*, *feathers.* These they strew over the soil, and slightly cover, when it is nearly ready for sowing.

For the maize crop they sometimes use *liquid manure*, as I witnessed, in the neighbourhood of Milan. This is carried to the fields in water-carts, and applied with a species of wooden shovel. Clovers, and other artificial grasses (the never-failing attendants of good husbandry) are seen throughout.

The soil of this region varies considerably. The banks of the Po, the Brenta, and most of their

tributary streams, including the vicinity of Ferrara, are alluvial; and from the miasmata they originate during the summer months, are almost as devoid of agriculture and inhabitants as the *Campagna.*

From Padua to Vicenza, and along the banks of the *Bacchiglione,* which waters the latter, the soil is a species of rich loam, and in a state of high cultivation. On the contrary, the greater part of the March of Ancona, together with the immense plain of Lombardy, is, for the most part, a light friable mould, resting on a porous sub-soil, composed of limestone-gravel and other calcareous substances, and is necessarily indebted for its fertility to the great industry and skill employed in its cultivation.

The numerous streams that descend from the Alps and Apennines into the great plain of Lombardy, are husbanded with the utmost care for the purposes of irrigation. Canals extend from these in all directions, and with their subordinate branches convey into almost every field this vital element, deprived of which vegetation would necessarily disappear in them from their being so exposed to the parching fervour of their summer skies.

Thus, not only are the lands (with the exception of part of the alluvial districts mentioned before) generally in a state of cultivation throughout this extensive region; but every aid, whether

natural or artificial, that can be brought in to add to their fertility, is anxiously attended to and turned to account.

The consequences are, that with a number of towns or opulent cities, almost unprecedented in such an extent, and teeming with population, plenty so much abounds, that the necessaries and even luxuries of life are within the reach of the most humble of society; and despite of the exactions of foreign rulers, poverty and misery are nearly unknown. This proves that were her natural advantages everywhere turned to account with equal care, Italy would not only be *the garden of Europe* as to beauty, but a country which for the advantages of soil and climate, and abundance of agricultural produce, could not be surpassed, perhaps, by any in the universe.

Let us hope that her rulers, at length awaking to their own interests, as well as to those of their subjects, will take advantage of the lights that inquiry is daily supplying, to convert the frightful deserts of her *Maremma* into the heart-cheering theatres of active industry and health; that removing the great bar to their improvement, they will cause the soil of so many heroes no longer to be a contrast to, and the foul stain of her bright horizon, consigned to pestilence and solitude; but restored to the noble purposes of which it is susceptible, and for which it would appear to have been designed by nature, it may furnish an additional

and memorable testimony of the triumph of science over the most difficult impediments opposed to her; and one the most consolatory to the heart of the philanthropist.

I shall conclude this article with enumerating some of the most valuable products which the *Maremma* of Italy is capable of yielding, to give an idea of its natural advantages. These are, (in addition to the various kinds of grain pulse, *&c.*, *&c.*, common to England,) *rice, cotton, maize, tobacco,* and *madder*, &c. But that from which probably it would derive the greatest advantage, from the superior richness of its soil, would be the cultivation of *hemp*; this as well as the redundance of its other produce, (from its vicinity to the sea,) might be shipped for foreign markets, with the utmost facility. It might likewise draw considerable wealth from increasing the growth of *raw silk*, and of *the vine*, as one of the most esteemed wines of ancient Italy (the *Cæcuban*) was produced in part of it. In addition to these, *fruits* in great variety and of exquisite quality, such as the orange, lemon, pomegranate, *&c.*, luxuriate here.

Nothing, therefore, is wanting to develop its various sources of wealth, and restore to it its *Saturnian age*, but the aid of science, seconded by active industry.

ON THE DETERIORATION OF QUALITY OBSERVABLE IN THE ITALIAN WINES.

I CANNOT more appropriately conclude this essay on Italian husbandry, than with some observations on the falling off in quality, so remarkable in the wines of that country.

As illustrative of this I give the following extract from *Mr. Eustace's Classical Tour*—" the two most celebrated wines of Italy were the *Cæcuban* and the *Falernian ;* the first according to Pliny was produced in the *poplar groves that rose in the marshes on the bay of Amyclea,*" i. e., the small plain extending from *Fondi* to the sea, and bounded on the south by *Mount Cæcubus.* The latter a little further south in the district called the *Falernus Ager,* which lies between the sea, *Mount-Massicus, Callicula,* and the river *Vulturnus,* being a little to the north of modern *Capua.*

" It has often been asked," he continues, " why Italy does not now produce wines so excellent, and in such variety as anciently; and it has been as often answered, either that the climate has changed, or that the cultivation of the grape has been neglected and the vines allowed to degenerate for want of skill and attention. As for the first of

these reasons, we find nothing in ancient authors that can furnish the least reason to suppose that any such revolution has happened. The productions of the soil are the same, and appear at the same stated periods; the seasons correspond exactly with the descriptions of the poets; the air is in general genial and serene, *&c.* Neglect and ignorance are reasons more plausible, but will not perhaps, on examination, be found much more satisfactory. Arts essential to the existence of man, when once known, are never forgotten, and articles so necessary as bread and wine cannot possibly be entirely neglected. The science of tillage passes from father to son, and cannot be obliterated, unless the whole population of a country be at once destroyed, and a link struck out of the chain of human generation. Moreover the mode of gathering and pressing the grape, of boiling and storing the wine is nearly the same now as anciently. Besides, from the reasons given above it would follow, that the culture of the vine was lost all over Italy, Greece, and Sicily, and that the vine itself had degenerated in all countries that lie south of the Alps, however favourable in other respects by nature. It may finally be observed that several of the wines celebrated in ancient times still retain, at least, some share of their ancient reputation." Here he enumerates those of the Italian wines that *have been*

and *are* most esteemed, concluding with that called the *Lachrymæ Christi,* produced by the vines that flourish on the sides and round the base of Vesuvius.

The arguments here advanced by Mr. Eustace, though founded in common sense, and in the nature of things as relates to society, are not, however, everywhere borne out by the fact, particularly as to the *climate of Italy*, which, as is shewn in the first part of this work, has, in common with that of most countries of southern Europe, undergone a considerable change in the main standard both of its summer and winter temperature, insomuch that it is probable the centre provinces of France approximate at present more in their main temperature to the former temperature of those of the south of Italy, than these southern provinces of Italy do in our times, to that which they formerly experienced.

That much *depends on climate* in the production of good wine, few will dispute, and that *soil* has a still greater influence than climate in contributing to this effect is a position equally incontrovertible. That much likewise depends on *the season*—on the time of gathering the grapes, and particularly on the process of making the wine, is equally true.

That the Romans are very inferior in skill to their neighbours beyond the Alps in the process

of making wine, was proved when the French were in possession of Rome, for (as I was informed) the latter made some wine while there, from the neighbouring vineyards, that when exposed for sale, brought nearly *double the price* in the market which the wine made by the Italians from *the same grape* would bring.

But though the Italian mode of making wine is palpably defective, particularly in their practice of mixing water with the *must* (a common practice as I was informed) to increase the quantity; and though the *climate*, as regards the vine, is certainly not improved *; yet, as particular situations with regard to soil, and the requisite fitness of temperature, are not wanting to Italy, to ensure there the production of as good wines as those of France, and as exceptions must exist in that country to the general want of skill in the process of making wine, to discover the real cause of de-

* I consider *cold to a certain degree* in winter to be almost as essential in giving *that quality* to soils which is necessary to ensure to them the production of *good wine*, as it can be in giving that which is necessary to ensure excellence in the production of any other crop; and which in my opinion follows from the action of frost and snow on soils *in increasing their absorbent power*, the vine perhaps more than any other plant (to have its produce of superior quality) requiring to draw the largest proportion of nutriment from the atmosphere. In this, the difference of the absorbent quality in soils, probably consists the true secret of the excellence of some in the production of superior wines.

terioration in the wines of Italy, it becomes necessary to refer to *first principles,* and to see if it be according to *these* that the vine has been *propagated in Italy ;* as if not, it will be unnecessary to search further for the cause, this of itself being amply sufficient to account for it.

The mode of propagating the vine in Italy, as in other countries, is by *cuttings* taken from the parent stocks ; and these in process of time become the *stocks* from which cuttings for other vineyards are taken. *This mode* is that by which the vineyards in Italy have, without interruption, been propagated from the introduction of the vine into that country down to our times.

But is this the mode ordained by Nature? Most certainly not. The mode intended by her for the propagation of all her vegetable products *is by their seed,* and where is the seed of the vine to be found, but in the grape?

Now, it is an established truth, that any deviation from the order established by nature *in propagation,* cannot be persisted in without deteriorating in quality any of her productions that have been exposed to such abuse, or totally destroying them.

Accordingly, in the *apple-tree* and others, it becomes necessary, within certain periods, to renew them from the seed, as grafting, however skilfully performed, will not prevent the fruit from deteri-

orating in quality; till at length it becomes not worth the trouble of cultivating, and that Nature has not made the vine an exception in this her general law, the instance before us, is, I conceive, a sufficient proof.

The cause of this deterioration in fruit trees, *&c.*, in propagating them from *cuttings*, either planted in the earth, or grafted, appears to be, that the wood or fibre gradually undergoes a change, becoming too compact or hard, and consequently losing that *succulency* necessary for the production of good fruit. For this tendency to run to fibre, nature has left no means of prevention but by renewal from the seed itself.

It will naturally be asked, why this system of propagating the vine has not produced similar effects in France and elsewhere? The answer is, that this change in the vine is so slow as to be effected by almost imperceptible degrees; that transplanting it from a southern to a more northern temperature may have the effect of lessening still more this tendency in the *fibre;* and, as is well known, that the introduction of the vine into France is modern, as compared with Italy. But that which more than any other circumstance prevents this tendency in the French vines is the mode practised in cultivating them; as *the stocks* are seldom allowed to rise more than a foot or two above the surface of the earth; and after the vin-

tage every year they generally undergo the operation *of heading*, or cutting off the last year's growth of branches, *so as to prevent the same stem from yielding fruit a second year.* This seems to be doing as much as art can do in adhering to the intentions of nature, when propagation from the fruit itself is neglected.

As the contrary of all this is observable in the Italian practice, with some few exceptions, (they allowing the vines to grow and extend themselves over trees of considerable elevation, with which they are usually of equal standing in the soil,) it is by no means strange that the wines of Italy are generally of the wretched quality we find them.

One of the exceptions here alluded to in the Italian practice of cultivating the vine, is the mode of cultivation of the vineyards about the base of *Vesuvius*, from which the *Lachrymæ Christi* is made, and to this mode probably is to be attributed much of the superior quality of that wine; while to the great absorbent powers of the soil, from being in great part composed of volcanic cinders, is certainly due much more.

Here I think it right to remark that as the *Campagna di Roma* and the greater part of the *Maremma* is a volcanic region, though volcanos have long been extinct in it; and as it is known that lime and other calcined substances, when ex-

posed to the atmosphere, lose in the course of time much of their absorbent powers, the quality of the soil in this region may have undergone, since the time of *Romulus*, a material change in *its absorbency*, which must have an effect not only on the vine, but on the atmosphere itself.

FINIS.

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